Eight storms were found to have occurred in 1899. Tracks for these storms are presented in Fig.2.

Storm 1, 1899 (Jun.26-27), T. S.

This is a new case which has been recently unearthed by the author of this study; therefore, this case is not included in Neumann et al. (1993).

Documentation of this case was based on the following information: 1) The recent flood resulted from heavy rains which set in near the mouth of the Brazos River on the afternoon and night of Jun.26 and progressed slowly inward until Jun.28, when phenomenal heavy rains occurred on the central position of the Brazos River drainage basin. The heaviest rain were recorded as follows over the 72 hours ending at 8 A.M. Jun.28: Alvin, 7.27 inches; Brazoria, 7.83 inches; Galveston, 3.20 inches. The heavy rains appears to have resulted from a semitropical storm which had moved northward from the central portion of the Gulf of Mexico. The storm was first noted on the morning map of Jun.26, 1899 and later in the day a high tide and heavy swell at Galveston indicated a storm of considerable energy at sea to the S. of Galveston. Storm signals were displayed at Galveston on the afternoon of Jun.26. During the night of ,Jun.26 the storm moved inland and its energy had greatly diminished from that at first shown by the ocean. The lowest barometer recorded at Galveston during the storm was 29.74 inches at 8 P.M. Jun.26. Judging from the progressive movement, the storm died out as it moved inland at the slow rate of about 5 mph. The heaviest rainfall occurred at the coast 24 to 36 hours earlier than at Hearne and Waco. A study of the rainfall at all stations shows the progressive move of the storm inland, notwithstanding the barometer gradients at the surface were not sufficient after the storm left the coast to indicate the position of its center on the chart. (Monthly Weather Review, Jun. 1899). 2) Observations taken at 8 A.M. (E.S.T.) and extracted from weather maps: Jun. 26, ship near lat. 28 N., long.92 W., wind S.E. force 6, barometer 29.80 inches; Galveston, wind N.E. force 3, barometer 29.86 inches. Jun 27, Galveston, wind S.E. force 6, rain, barometer 29.78 inches; Corpus Christi, wind N.W. force 3 barometer 29.85 inches (Historical Weather Maps, Jun. 1899). 3) A storm of some intensity appears to be developing in the West Gulf. Galveston reports a N.E.

wind of 30 mph (The New York Times, Jun.27, 1899, p.3, col.4). Author's note: This statement was probably issued in the evening of Jun.26. 4) Austin, TX, Jun.29. All S.W. and central Texas has today been visited by terrific rainstorms which have practically tied up all the railroads in this section of the state. Many acres of farming land in South Texas are under water tonight and much cotton will be badly damaged. (The New York Times, Jun.30, 1899, p.1, col.2). 5) Austin, TX, Jul.1. The terrific rains in central Texas continue and the overflowing creeks and rivers are devastating growing crops and other property. The Brazos River is the largest flooded steamer. State Senator Davidson of Cuervo arrived here this evening and stated that the Guadalupe and Colorado Rivers in that section are flooding the low country. The fall was 8 to 10 inches in 18 hours (The New York Times, Jul.1, 1899, p.2, col.3). 6) Austin, TX, Jul.1. There has been another 24 hours of continued heavy rainfall throughout the flooded district of S. and central Texas, with the result that rivers had their overflow greatly augmented, inflicting additional loss and damage to the agricultural interests (The New York Times, Jul.2, 1899, p.1, col.6). 7) Austin, Jul.2. There is no improving in the distressing situation in the flooding districts of S. and central Texas. On the contrary, the inundation is growing worse (The New York Times, Jul.3, 1899, p.1, col.7).

The author of this study produced an approximate track for Storm 1, 1899. The author's 7 A.M. Jun. 26 position was estimated near 27.5 degrees N., 93.0 degrees W. on the basis of the ship observation in item 2). The author's 7 A.M. Jun. 27 position was estimated near 29.5 degrees N., 97.5 degrees W. and was based on general information in item 1) and on specific wind and pressure information at Galveston and Corpus Christi for the morning of that day (item 2). Although it is likely that the storm weak circulation still existed on Jul.28, no attempt was made to estimate any position due to the reasons discussed in item 1). The author's track for Storm 1, 1899 is shown in Fig.2.

Information in item 1) regarding the high tide and heavy swell which were experienced at Galveston late on Jun.26, prompted the author to classify this weather system as a weak to moderate tropical storm. However, the most important feature associated with this storm was the very extensive flooding over positions of Texas which resulted from the heavy rains that set in along the Texas coast in the afternoon and evening of Jun.26 (item 1) and then spread inland, where they continued for several days (items 4 through 7).

Storm 2, 1899 (Jul.28-Aug.2), H.

This is the same storm that Neumann et al. (1993) identify as Storm 1, 1899.

The following information was found in relation to this storm: 1) Port de France, Martinique, Jul.31. News is arriving slowly owing to the occurrence in Santo Domingo on Friday (Jul.28) of a violent hurricane which caused damage. Three large schooners which were in the roadstead of Santo Domingo were wrecked, and only one man of the crews of the 3 vessels was saved. The hurricane moved to the N.E.(?) between Santo Domingo and Cotuy, 44 miles from the capital. Telegraph lines suffered heavily and great damage was done along the sea coast (The New York Times, Aug.1, 1899, p.7, col.3). Author's note: The storm movement to the N.E. appears to be in error. 2) Observations which were extracted from 8 A.M. (E.S.T.) weather maps: Jul.29, Santiago de Cuba, wind W. force 1, barometer 29.92 inches; Camaguey, wind N.E. force 3, barometer 29.87 inches; Port-au-Prince, wind E. force 7; barometer 29.96 inches; ship near lat. 21.2 N., long. 74.4 W., wind S.E. force 7. Jul 30, ship near lat. 24.5 N., long.83.5, wind S.W. force 5; Key West, wind S.W. force 4, rain, barometer 29.97 inches; ship near lat. 25 N., long. 80.5 W., wind S. force 7, barometer 29.88 inches. Jul.31, ship near lat. 26 N., long. 87 W., wind N.W. force 3, barometer 29.97 inches; ship near lat. 25.5 N., long. 84.7 W., wind S. force 3; Key West, wind S. force 3, barometer 30.00 inches; Tampa, wind S.S.E. force 5, barometer 29.88 inches; ship near lat. 24.5 N., long. 83 W., wind S.W. force 6 (Historical Weather Maps, Jul.1899). 3) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps; Aug.1, Pensacola, wind N.N.E. force 3, barometer 29.94 inches; Port Eads, wind N.N.W. force 3; Tampa, wind S.S.E. force 3, barometer 29.98 inches; Jacksonville, wind S. force 4, barometer 30.00 inches. Aug.2, Pensacola, wind N.W. force 2, barometer 29.96 inches; Montgomery, wind N.E. force 3, barometer 29.98 inches; Port Eads, wind N.W. force 3; ship near lat. 27.5 N., long. 88 W., wind S.W. force 5 (Historical Weather Maps, Aug.1899). 4) Taken from a report by A.J. Mitchell, observer and section director of the Weather Bureau: At Carabelle, Fl., over which the center of the storm doubtless passed, the wind was fresh and brisk from the N.E. on Jul.31, and increased gradually until sunrise Aug.1, when the gale was furious. At noon of the same day almost a calm prevailed. Within a short time the wind increased to a furious gale from the S.W., which continued until nearly sundown, the wind gradually diminishing with a W. backing to S. direction. The diameter of the storm was not more than 40 miles and its force was spent before it progressed 50 miles inland. Great damage befell the town of Carabelle where no more than a score of unimportant houses

withstood the storm. The results to shipping was disastrous. The following vessels, most of then loaded, were wrecked: 14 barks, 40 small boats under 20 tons., and 3 pilot boats. The number of persons drowned and killed was 6. (Monthly Weather Review, Aug. 1899). 5) Tallahassee, FL, Aug.2. The town of Carabelle, S.W. of this city, is reported almost completely destroyed by a terrific wind and rain storm which passed through the section during yesterday and last night. Many boats which were in the harbor have been wrecked and the greater portion of the long wharf, together with large portions of many stores at Lanark, the large pavilions and the boats have been destroyed. Unconfirmed reports say that the steamer "Crescent" have been lost between Apalichicola and Carabelle (The New York Times, Aug.3, 1899, p.2, col.3). 6) Tallahassee, FL, Aug.3. The first train from Carabelle through the storm-stricken Gulf section since Monday (Aug.1) reached here this afternoon. Carabelle is literally wiped from the map. Thirteen of the 14 lumber vessels in the bay were blow ashore and are now lying well up on dry land. The towns of McIntyre and Curtis Mill are completely demolished and large interests have been destroyed. The coast resorts St. Teresa and Lanark are more seriously wrecked than at first reported. 15 men who seem to have been fishing on the Dog Island Inlet before the storm broke cannot be found (The New York Times, Aug.4, 1899, p.6, col.7). 7) Storm of Aug.1, 1899. Carabelle, FL. Minimal, 6 killed (Dunn and Miller, 1960).

Some modifications were introduced to the track for this storm in Neumann et al. (1993), which was started over the eastern Gulf of Mexico on Jun.31. as for Storm 1, 1899. On the basis of information in the above items, the author of this study determined an approximate track for Storm 2, 1899, starting three days earlier and about 1000 miles to the S.E. The author's 7 A.M. Jul.28 position was estimated near 17.0 degrees N., 69.5 degrees W. on the basis of information in item 1) which indicates that the storm was felt in Santo Domingo that day. The author's 7 A.M. Jul.29 position was estimated near 21.3 degrees N., 75.7 degrees W., on the basis of an analysis of the corresponding observations for that morning which are contained in item 2). Based on meteorological data contained in item 2), the author of this study estimated 7 A.M. positions near 25.3 degrees N., 81.0 degrees W. on Jul.30 and near 27.5 degrees N., 83.5 degrees W. on Jul.31, being this latter position about 90 miles to the E.N.E of the corresponding one shown in Neumann et al. (1993). The author's 7 A.M. Aug.1 position was estimated near 29.3 degrees N., 84.5 degrees W., primarily on the basis of the storm description at Carabelle and vicinity given in item 4); this position is slightly to the S.S.E of the one shown in Neumann et al. (1993). Finally, the author estimated a 7 A.M. Aug.2 position near 31.5 degrees N., 86.0 degrees W., based on the wind and pressure information for Pensacola and Montgomery in the morning of Aug.2 (item 3); this position is nearly 100 miles to the

W.N.W of the corresponding one displayed in Neumann et al. (1993) as for Storm 2, 1899. The author's track for Storm 2, 1899 is shown in Fig.2.

Information in items 4) through 6) was found to support the hurricane status given to this storm by Neumann et al. (1993), particularly because of the amount of damage described in those items. The author of this study decided to keep the storm as a hurricane only from late Jul.31 to the evening of Aug.1, just a few hours after the storm made landfall on the coast near Carabelle. Although the storm was referred to as a "violent hurricane" at Santo Domingo" (item 1) the author decided against giving hurricane status at landfall on the southern coast of that island due to the lack of confirmation that this was the case.

Storm 3, 1899 (Aug.3-Sept.3), H.

This is the same storm which Neumann et al. (1993) identify as Storm 2, 1899. The storm attained great intensity while crossing over Puerto Rico where it is known as that of San Ciriaco because it was felt there on Aug.8, the festivity of that Catholic saint. It was also a very intense hurricane when it was felt on the North Carolina coast on Aug 17-18.

Abundant information was found in relation to this storm: 1) From an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: Information concerning tropical storms at or near their place of origin is almost wholly lacking, and much interest attaches to the report of the British steamship "Grangense" which vessel encountered the hurricane 1800 miles E. by S. of the Island of Guadeloupe. The "Grangense" passed through the center of the storm and took very careful and complete observations, warranting the publication of her log in full, as follows: At noon of Aug.3, in lat. 11 51 N., long. 35 42 W., we experienced a sudden change in the weather which, being most unusual in this part of the world, is worthy to note. Early in the afternoon the barometer began slowly to fall from 29.93 inches. At 2 P.M. it stood 29.73 inches, the sky becoming overcast with cumulo-nimbus clouds and the wind refreshing to a moderate gale from N.N.W. At 4 P.M. the barometer read 29.53 inches, the wind remaining from the same direction with force increased to a fresh gale, accompanied with heavy rain. At 5 P.M. the barometer reached its lowest reading, 29.38 inches, while the wind fell calm and the rain ceased; very heavy nimbus clouds traveled overhead at a high speed from the S.W. and a high, short and dangerous sea from the

N.E. caused the ship to pitch heavily and made it necessary to let her head fall off to the E. in order to make headway, the ship being very light. At 6:30 P.M. a light breeze came out of the S.S.W. and the barometer rose to 29.43 inches, clearly indicating that the center had passed. At 7 P.M. the wind increased to a strong S.S.W. gale, with excessive rain beating down the N.E. seas and enabling us to return to our course, N.E. one-quarter E. At 8 P.M. the barometer stood at 29.58 inches, with a moderate gale hauling gradually southward. After two heavy squalls at 10 P.M. the weather cleared, barometer 29.73 inches, steadily rising; sea coming up from S.S.E, sky clearing and starts shining out again; strong breeze hauling to E. And so finished this little storm which showed all the symptoms of a genuine West Indian hurricane underdeveloped, with the exception of the sea in the vortex which, instead of being confused, came almost suddenly from the N.E. and remained from that quarter until the wind and sea from the receding semicircle overwhelmed it. Captain Spedding, who has been in this particular trade, from Europe to the river Amazon, for many years and many others on board who has been long acquainted with these regions say they have never experienced any weather of a cyclonic character so far to the eastward before (Monthly Weather Review, Oct. 1900). 2) Observations taken at 8 A.M. (E.S.T.) which were read off weather maps: Aug.3, ship near lat. 11.7 N., long. 35.5 W., wind N. force 6, barometer 29.91 inches; ship near lat. 7.7 N., long. 32.7 W., wind S.W. force 6. Aug.6, ship near lat. 18.7 N., long. 53.0 W., wind N.E. force 7, barometer 30.00 inches. Aug.7, Dominica, wind N.W. force 3, barometer 29.71 inches; Martinique, wind W., force 2, barometer 29.74 inches; Barbados; wind S. force 5, barometer 29.85 inches (Historical Weather Maps, Aug.1899). Author's note: The ship near lat. 11.5 N., long. 35.5 W. on Aug.3 appears to be the "Grangense" which observations were given in item 1). 3) At 8 A.M. Aug.7, the hurricane center was E.N.E. and distant about 150 miles from the Island of Dominica. At Roseau, Dominica, the barometer read 29.72 inches, with rain and wind from N.W. blowing at 12 mph. Immediately upon receipt of the 8 A.M. telegraphic reports, the central office of the Weather Bureau at Washington ordered hurricane signals at Roseau (Dominica), Basseterre (St. Kitts) and San Juan, and sent advisory messages to all other stations in the Lesser Antilles and also to Santo Domingo, Kingston and Santiago de Cuba, with information regarding the position and probable course of the hurricane. During the next 24 hours the hurricane traveled W.N.W. at a speed of about 16.5 mph, crossing directly over the island of Guadeloupe in the afternoon, and passing 50 to 70 miles south of St. Kitts late in the afternoon of Aug.7 and reaching the S.E. coast of Puerto Rico shortly after 8 A.M. Aug.8 (Monthly Weather Review, Aug.1899). 4) Fort de France (Martinique), Aug 8. At 11 A.M. yesterday morning (Aug.7) a cyclone struck Point-a-Pitre, Guadeloupe. the disturbance lasted until 4:30 P.M. Many houses had their roofs blown off and

were flooded and some of them were demolished. All communications with the interior of the island, where damage done is considerable, has been interrupted. At (Les) Saintes two schooners were sunk and some flat boats were driven into the interior. The plantations suffered greatly (The New York Times, Aug.9, 1899, p.1, col.3). 5) Barbados, Aug.10. Ship "Madiana" has arrived damaged about the decks; passed through a cyclone Aug.7 (The Times, London, Aug.11, 1899, p.4, col.5). Author's note: In addition, the Times, London, Aug.12, 1899, p.8, col.5, published a dispatch from St. Kitts, dated on Aug.11, announcing that the barque "Savora", from Trinidad to Trieste, was towed there with loss of sails. This event was probably related to this storm. 6) New York, Aug.7. A telegram from Kingston, Jamaica, announced that a terrific hurricane swept over Dominica this afternoon traveling W.N.W. The shipping along the threatened area has been warned (The Times, London, Aug.8, 1899, p.4, col.4). 7) Taken from an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: When the hurricane reached Monserrat (on Aug.7) the area of the storm had increased, the barometer was almost two inches lower (than on Aug.3), having fallen to 27.45 inches, the wind blew with hurricane force, causing immense damage and loss of life, and the rainfall was excessive (Monthly Weather Review, Oct. 1900). 8) Taken from a letter by Major General Robert Fowler-Butler, Commanding Troops, Barbados: The hurricane passed over Monseraat on Aug.7. On Wednesday falling I arrived there on my military inspection tour. The pier was blown away and all the material newly laid in for its extension gone to sea. The Courthouse and a school are standing and crowded with homeless women and children. Not a church or parsonage is standing in the island. There are so far about 100 deaths and 1400 injuries (The Times, London, Aug.31, 1899, p.8, col.6). 9) Observations taken at St.Kitts: At 3 P.M. Aug.6, the wind set in steadily from the N.E. at the rate of 12 mph. At 10 P.M. the barometer began to fall and the wind had attained a velocity of 18 mph. By 3 A.M. Aug.7, the wind was blowing at a rate of 24 mph and there was an apparent tendency to cloudiness so that by 5:30 A.M. the sky was almost entirely overcast with low clouds, from which frequent showers fell. The storm came from the S.E., and the center passed a little to the S. of the island, the barometer reached its lowest reading at 5 P.M. when it stood at 29.27 inches; after this hour it began to rise rather gradually. The wind continued from the N.E. until 6 P.M., when it veered to the E. where it remained until about 8 P.M.; it then veered to the S.E. and so continued until the end of the storm. The maximum velocity (greatest velocity for any 5 minutes) was 72 mph and occurred between 4:22 and 4:27 P.M. The extreme velocity (one mile in the shortest time) occurred at 4:40 P.M. and blew a mile in one-half minute or at a rate of 120 mph. The verifying velocity (45 mph) began at 2:34 P.M. and ended at 12:25 A.M. Aug.8; the storm therefore lasting nine hours and fifty one minutes. The hurricane was accompanied by a light rain, the

total amount of which was 1.28 inches; the heaviest fall occurred between 4:53 and 5:10 P.M. (Alexander, 1902). 10) Some additional pressure observations taken at St. Kitts: Aug.7, noon, 29.74 inches; 2 P.M., 29.62 inches; 3 P.M, 29.52 inches; 4 P.M., 29.38 inches; 4:30 P.M, 29.30 inches; 5:30 P.M., 29.29 inches; 6 P.M., 29.33 inches; 7 P.M., 29.44 inches; 8 P.M., 29.60 inches; 10 P.M, 29.72 inches; midnight Aug.7-8, 29.74 inches (Monthly Weather Review, Aug.1899). Author's note: The above observations were sent to the Weather Bureau by W.H. Alexander, the observer at Basseterre, St.Kitts. 11) Taken from a report by C.W. Doelizsch, Officer of Customs, St. Martin: During the afternoon of Aug.7 the weather was gloomy and squally, with wind increasing to E.N.E. and going to E. At 10:28 P.M. the barometer read 29.81 inches, and the storm was increasing. This was the last observation taken of this hurricane (Monthly Weather Review, Aug. 1899). Author's note: The barometer reading of 29.81 inches appears to be too high. 12) Taken from a report by Mr. John B. Simons, Saba, Dutch West Indies: At 4 P.M. (Aug.7) the wind was from N.E. and increasing. The barometer continued to fall until 11 P.M., when I judged the wind to be from the N., after which it remained steady until midnight (Aug.7-8) when it shifted to S.W. and the barometer began to rise. The minimum reading by an aneroid barometer was 29.40 inches. There was no means of measuring the wind velocity but I estimated it at 55 to 65 mph. This island is high and mountainous and contains no low land. (Monthly Weather Review, Aug.1899). Author's note: The winds given might have not been responding to the hurricane circulation but to local effects associated with the mountainous terrain. The timing of lowest pressure shortly before midnight Aug.7-8, was found to be inconsistent with the storm motion and to be incompatible with the time of lowest barometer at St.Kitts, only about 40 miles to the S.E. of Saba, which occurred at 5 P.M. Aug.7 (item 9). However, there is still a possibility that the observations at Saba were expressed in Greenwich time, in which case the reported time of lowest pressure (about midnight Aug.7-8) would make sense. 13) St. Thomas, Aug.10. The island of Monserrat was completely devastated by the hurricane Monday (Aug.7). All the churches, estates and villages were destroyed and nearly 100 persons were killed (The New York Times, Aug.11, 1899, p.1, col.7). 14) Washington, Aug.9. The American Consulate at Point-a-Pitre, Guadeloupe was wrecked. Consul Ayme reports that a great many vessels were lost and that the damage done to the city was great. (The New York Times, Aug.10, 1899, p.1, col.2). 15) London, Aug.10. The Governor of the Leeward Islands sent a dispatch which says that 74 deaths are already known at Monserrat and that 21 persons were killed in the island of Nevis. (The New York Times, Aug.11, 1899, p.1, col.7). 16) St. Thomas, Aug.9. A severe hurricane swept over the island of St. Croix Monday night (Aug.7). Nearly every estate has been wrecked, the large buildings in the town have been unroofed, stock has been killed and a maximum of 11 deaths have

occurred among the laborers. On St. Kitts about 200 small houses were destroyed and considerable damage was done to the estates. Antigua has suffered severely in damage to estates and buildings in the towns; there were a few fatalities. The force of the storm was also felt at St. Thomas but the damage done was slight. Enormous seas, however, did damage to the wharves (The New York Times, Aug.10, 1899, p.1, col.2). Author's note: Alexander (1902) added that, at St. Kitts, a number of very substantial buildings were blown down and the canes were badly damaged. 17) St. Thomas, Aug.7. There are hurricane indications over the area from Martinique northward and it is feared the storm may strike some island, probably Guadeloupe (the New York Times, Aug.8, 1899, p.1, col.6). 18) Washington, Aug.7, 2:53 P.M. The following warning has been sent out by the Weather Bureau: Hurricane center E. of the Island of Dominica, apparently moving N.W. Hurricane signals are displayed from Dominica to Santo Domingo. H.E. William, Acting Chief of the Weather Bureau (The New York Times, Aug.8, 1899, p.1, col.6). 19) Kingston, Aug.7. It is reported from the island of Dominica that a severe storm was sweeping over there this afternoon, travelling W.N.W. and heading for Jamaica. (The New York Times, Aug.8, 1899, p.1, col.6). 20) Santo Domingo, Aug.7. Advices that the hurricane is approaching have been received from various parts of the "Republic of Dominica" and the barometer here is falling rapidly. The Dominican warships had sailed for Caldera, a part of refuge on the south coast (The New York Times, Aug.8, 1899, p.1, col.6). 21) Santo Domingo, Aug.8. The cruiser "New Orleans" put to sea this morning at 4:00 A.M. The barometer then stood at 29.81 inches and as this dispatch is filed the register shows 29.85 inches (The New York Times, Aug.9, 1899, p.1, col.3). 22) Washington, Aug.8, 10:45 A.M. The following bulletin was sent out: Telegraph communications cut off E. of Santiago de Cuba. Hurricane center apparently moving towards Puerto Rico (The New York Times, Aug.9, 1899, p.1, col.3). 23) Taken from a report by R.M Geddings, section director, Weather Bureau, San Juan: During the afternoon of Aug.7 the sky was unusually hazy (at San Juan), and the lower clouds were rapidly moving from the N.E. At 3 P.M. the sky was covered by thick alto-stratus and stratus clouds, the former coming from the S.E. and the latter from E.N.E.; at this time the barometer registered 29.87 inches. At 10 P.M. the barometer began its downward movement, which did not cease until the lowest reading, 29.23 inches, was reached at 8:30 A.M. Aug.8 at which time the mercury in the tube was oscillating violently. The wind reached no very high velocity until 2 A.M. Aug.8. At 5 A.M. Aug.8 it was raining and blowing furiously, both increasing until between 7 and 9 A.M. the hurricane was at its height, the wind reaching a registered velocity of 66 mph from the N.E. The wind shifted during the progress of the hurricane from N.E. to S.E. The storm passed to the S. of San Juan, and striking the island (of Puerto Rico) on the S.E. part, passed in a direction N. of W. until it passed the N.W. part, the time consumed in its

passage being from 7 A.M. to 1 P.M. The rainfall during San Ciriaco (as the hurricane is known in Puerto Rico) was excessive, as much as 23 inches falling at Adjuntas during the course of 24 hours. This caused severe inundation of rivers with which Puerto Rico is so liberally endowed, and the deaths from drowning numbered 2,569 as compared with 800 killed by injuries received from the effects of the wind (Garriott, 1900). Author's note: Similar information was also published in Alexander (1902). 24) Extracted from a report by R.M. Geddings, Section Director, Weather Bureau, San Juan: At Guayama a reading of 27.80 inches was made on an aneroid barometer which has since been compared and found to read 0.20 of an inch too high; allowing for difference in elevation, the reading of the instrument, corrected, was about 27.75 inches. I was disposed at first to doubt this reading, but a report from the voluntary observer at Juana Diaz records a reading of 28.11 inches at 9:30 A.M. The lowest barometer was reached at Mayaguez at 1:25 P.M. Aug.8. At Arroyo, at 5:30 A.M. Aug.8, barometer 29.30 inches; it fell rapidly until 8 A.M. when it read 27.90 inches; the wind blew from the N. until about 8:30 A.M. when there was a lull of about 15 minutes, then the wind changed and came from the S. with such terrific force that it appeared that nothing could stand against it. At Aguadilla the wind began blowing at 8 A.M. Aug.8 and increased in force to about 1 P.M., when perfect stillness reigned up to about 2 P.M.; after that the wind blew from the S. sometimes with tremendous velocity, until 7 P.M., after which it slackened gradually (Monthly Weather Review, Aug. 1899). Author's note: Guayama and Arroyo are located near the southeastern tip of Puerto Rico, Juana Diaz is inland a few miles to the N.E. of Ponce, Mayaguez is on the west coast and Aguadilla is near the northwestern tip of the island. 25) Taken from Hurricanes of the West Indies by Oliver Fassig, published in Washington in 1913 by the U.S. Weather Bureau: On August 8, 1899 one of the most destructive hurricanes in the history of Puerto Rico passed along the island. More than 3000 lives were lost, the majority of them drowned; the violent winds and torrential rains, completely destroyed a coffee crop which value was estimated over 7 billion dollars, almost all banana crops were blown down by the wind or washed away by river overflowing. And still we can see the effects of the storm in the abandoned coffee plantations, in which the growers lost their entire wealth. The center of the storm moved across the island in 6 hours, at a rate of 12 mph. At San Juan, 40 mph wind started to blow at 5 A.M. and continued to 10 A.M. This would indicate that the diameter of the cyclone was about 60 miles. On the basis of the reports received from Arroyo, the diameter of the storm should have been 80 to 85 miles. Rainfall lasted for 28 hours on the average, and with a forward motion of 12 mph, the rain area would be about 335 miles across.(Salivia, 1972). Author's note: Oliver Fassig was a professor of meteorology with the U.S. Weather Bureau who was the director of the office at San Juan,

Puerto Rico early this century. 26) Taken from "Descripcion del Ciclon de San Ciriaco", by Ramon Araez y Ferrando published by Imprenta El Heraldo in 1905: At Mayaguez, my two barometers read 754.2 millimeters (29.69 inches) at 4 A.M. Aug.8 and by then I did not have any doubt that the N. wind which had started to blow at 4 P.M. Aug.7 was the forerunner of the approaching storm. By 7:30 A.M. some 30 persons have taken refuge in my house, where they were friendly welcome. Using my military binocular, I looked at the bay of Mayaguez, and observed that the steamers "Vasco" and "Gillher", the schooners "Dichosa", "Concepcion" and "Elena", the "San Julian", the "Guadalupe" and other small vessels were anchored there. Later I saw the "Gillher" weathering the storm at the bay and I wished that the steamer could be saved as it actually happened. The "Concepcion" could not weather the storm and came shore on Sabalos Beach about 150 meters from my house. The "Vasco" got also loose and came ashore not far from the place where the "Concepcion" did. The schooner "Dichosa" came ashore just behind my house, and I welcomed the crew in. My house lost the roof in the middle of the cyclone and torrents of rain inundated the bedrooms. The night following the storm we and the neighbors who had taken refuge in my house, had to rest on wet chairs and rocking chairs. I took note of my barometric observations during the cyclone (some of the observations are reproduced here): 8:A.M., 29.65 inches; 9:20 A.M., 29.53 inches, the cyclone began; 10:50 A.M., 29.37 inches; noon, 29.06 inches; 12:30 P.M., 28.94 inches; 12:50 P.M., 28.90 inches; 1:06 P.M., 28.86 inches, cyclone at its height; 1:40 P.M., 28.94 inches; 2:40 P.M., 29.13 inches; 3:40 P.M., 29.41 inches; 4:37 P.M., 29.53 inches; 5:40 P.M., 29.68 inches; 7:15 P.M., 29.80 inches. The wind directions during the storm were: first from the N., then from the N.W., afterwards from the S. and finally from the N.W. (Salivia, 1972). Author's note: According to Salivia (1972), Ramon Araez y Ferrando was a retired officer from the Spanish Army who lived at Mayaguez. The N.W. wind direction which was reported as having blown at Mayaguez at the end of the storm was not representative of the cyclonic circulation; it was the product of some local effects or, else, it was a typographic error. 27) Washington, Aug.9. Hundreds of houses have been destroyed and several persons killed by the hurricane in the West Indies, according to advices received late this afternoon by the War and Navy Departments. Signal officer Glassford wired from San Juan, Puerto Rico that the calvary barracks there have been destroyed, the signal barracks, storehouses and many other public buildings and hundreds of native houses wrecked, telegraph and telephone lines are down and several people have been killed. The center and south of the island probably fared worse. Capt Snow, in command of the naval station at San Juan, announced by cablegram that about $2,000 worth of property have been destroyed at the station (The New York Times, Aug.10, 1899, p.1, col.2). 28) San Juan, Aug.10. A hurricane broke over the south coast at 1 A.M.

Tuesday morning (Aug.8) and swept N.W. There was no abatement for 9 hours, the greatest damage being done between 8 and 10 A.M. A dispatch by cable from Ponce sent at 10 A.M. this morning says the town was almost destroyed. At Aibonito very little remains standing, except the cathedral and the barracks. El Cayey was leveled to the ground. At Caguas 4 persons were killed. Humacao was totally destroyed. Forty-six bodies have been recovered and there are many more in the debris (The New York Times, Aug.11, 1899, p.1, col.7). 29) Ponce, Aug.10. The hurricane struck the place at 8 A.M. Tuesday morning (Aug.8) and lasted until 3 P.M. (The New York Times, Aug.11, 1899, p.1, col.7). 30) New York, Aug.13. According to a cablegram received from San Juan the port of Arecibo has been destroyed, the place having been inundated by both the sea and the river (The Times, London, Aug.14, 1899, p.4, col.4). 31) Washington, Aug.11. A report has been received here from an officer at San Juan estimating that the number of persons killed by the hurricane in the island amounts to 500 (The New York Times, Aug.12, 1899, p.1, col.7). 32) List of deaths in Puerto Rico: Humacao, 89; Cayey, 34; Yabucoa, 175; Aibonito, 23; Arroyo, 16; Guayama, 30; Juana Diaz, 5; Jayuya, 30. In addition, 300 persons were wounded in Humacao (The New York Times, Aug.31, 1899, p.4, col.3). 33) Puerto Plata, Aug.9, 11:30 A.M. A hurricane has swept the N. coast since last night and increases in violence. Shipping in the port is a peril but up to this hour no vessel has been damage (The New York Times, Aug.10, 1899, p.1, col.2). Author's note: Puerto Plata is located on the northern coast of the Dominican Republic. 34) Taken from a report by Louis Dorman, Weather Bureau Observer at Santo Domingo: The storm was not felt there until 5 A.M. Aug.9, and the greatest velocity recorded here was 35 mph from the S. at 3:45 P.M. The storm was accompanied by excessive rains both in the interior and on the coast. The Ozama River rose very high and it is believed that the northeastern coast of the island suffered more than the southern (Monthly Weather Review, Aug, 1899). 35) Hurricane of San Ciriaco (Aug.8) affected the Dominican Republic (Garcia-Bonnelly, 1958). Author's note: That country was affected late on Aug. 8 and also on Aug.9. 36) Kingston, Jamaica, Aug.9. The barometers are alarmingly low here and Turk Island reports a hurricane blowing, with rapidly falling barometer at 3:30 P.M., causing great excitement. 37) The steamer "Alfred Dumois" came yesterday (to New York) from Santo Domingo. While anchored off Santo Domingo harbor, the vessel was struck by the gale in the morning of Aug.9, and was obliged to run out of the harbor at 11 A.M. For 40 hours the "Dumois" could not get back. Several schooners came ashore in the vicinity of Santo Domingo (The New York Times, Aug.20, 1899, p.7, col.4). 38) The steamer "Isis" encountered the storm on Aug.9 (The New York Times, Aug.16, 1899, p.2, col.1). 39) The "Beverly" left Port Antonio, Jamaica at 9:50 A.M Aug.9. It was rounding Cape Maysi (eastermost tip of Cuba) at 1:45 A.M. Aug.10 when the glass showed that it was "in for it". The wind coming from N.W. got steadily

stronger. She attempted to reach the open sea via the Crooked Island Passage but the hurricane overtook the vessel when it was no more than 10 miles beyond Castle Island. It would be difficult to exaggerate the violence of the wind. Windows in the chart house were blown in by the pressure of the wind. The storm lasted 24 hours and during that time the captain was able to keep the steamer's head up to the sea (The New York Times, Aug.16, 1899, p.2, col.1). 40) The steamer "Themis" was struck by the hurricane off Castle Island on Aug. 10 (The New York Times, Aug.16, 1899, p.2, col.1). 41) The steamer "Herald" also arrived from Port Antonio. She was caught in the storm between Cape Maysi and Castle Island. She was in it for 19 hours on Aug.10, the wind blowing from W.S.W. first and then all around the compass (The New York Times, Aug.16, p.2, col.1). 42) The steamship "Arlene" stopped at Fortune Island to land some laborers on Aug.11. The captain learned that the island had been visited the night before by the hurricane, which has destroyed a large number of homes and other properties and driven several small vessels ashore . (The New York Times, Aug.16, 1899, p.2, col.1). 43) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Aug.9, Santo Domingo, wind S.W. force 6, barometer 29.73 inches; ship near lat. 17.5 N., long. 69 W., wind S.W. force 8; barometer 29.68 inches; ship near lat. 16.7 N. long. 68.7 W, wind S. force 8, barometer 29.65 inches. Aug.10, Santiago de Cuba, wind N.W. force 4, barometer 29.74 inches; ship near lat.19.7 N., long. 74.5 W., wind W.S.W. force 5, barometer 29.62 inches; ship near lat. 22.5 N., long. 75.4 W., wind N.E. force 4, barometer 29.71 inches (not clearly read off the map); ship near lat. 19.7 N., long 74.5 W., wind W.S.W. force 5, barometer 29.62 inches (Historical Weather Maps, Aug. 1899). 44) Aug. 10, 1899. The cyclone which devastated Puerto Rico on Aug.8 was felt with some force in Oriente province (Cuba). There was some damage, but it was not heavy (Sarasola, 1928). Author's note: Actually taken from the catalog of Cuban cyclones by M. Gutierrez-Lanza which is included in Sarasola (1928). 45) The cyclone which devastated Puerto Rico on Aug.8-10 was felt in Oriente, Cuba. (Martinez-Fortun, 1942). 46) A telegram has been received in the Colonial Office in reference to the hurricane at Fortune Island, from which it appears that the damage done is comparatively slight. Several vessels however, were stranded (The Times, London, Aug.17, 1899, p.4, col.3). 47) Nassau, Aug.13 (delayed in communication). The hurricane which broke here at 7 A.M. Friday night (Aug.11) and continued with great severity is ended, the center passing to the W. yesterday afternoon. The shipping in the harbor has been injured and many small vessels were lost. The Post Office is partially unroofed and the Government house is damaged. A preserving factory, a new sponge warehouse and many light buildings have been destroyed. The fruit trees and crops are badly injured, but there is little loss of life reported. No news has been received from the adjacent islands (The New York

Times, Aug.15, 1899, p.4, col.5). 48) Jacksonville, Aug.16. Advices have been received to the effect that the hurricane visited the island of Andros in the Bahamas, inflicting great damage to property and completely wrecking the sponging fleet. It is said that 150 bodies were washed ashore. At Nassau some damage was done but the extent of it is not stated. (The New York Times, Aug.17, 1899, p.3, col.1). 49) Jacksonville, Aug.18. According to a Miami dispatch to The Times Union and Citizen, the town of Red Bays, on the island of Andros was swept away in the recent hurricane and about 300 lives were lost. An eye-witness estimates the loss of life at the island as fully 600. The captain of the steamer "Cocoa" says that the wind blew at a rate of 90 mph at Nassau, with occasional gusts to 105 mph (The New York Times, Aug.,19, 1899, p.1, col.2). 50) Taken from a report by P.H. Burns, Superintendent of Bahamas Cable, Nassau. Number of small craft lost, 50. A few of these were swept out of Nassau by the E. wind; others were lost on Exuma Cays, some on Berry islands, but the majority on the sponge beds on both sides of Andros Island. The center of the storm passed between Nassau and Green Cay, which is 60 miles to the S., striking the settlement of Red Bays on Andros Island. N.E. wind did some damage there, backed to N.W. and fell dead calm. People came out to gather their scattered effects when the wind came from the S.W. with great force, bringing in heavy seas which caused great damage. The storm was severe at Bimini, where a few houses were destroyed. At Grand Bahama the storm was stronger that at Bimini and a few lives were lost. Conservative estimates place the total loss of life at 125, probably 100 occurring at Red Bays. A few sponge vessels are missing, which may swell the totals given (Monthly Weather Review, Aug, 1899). 51) Taken from a report by Thomas J.Mc Lain, U.S. Consul, Nassau, Bahamas: The storm began at Nassau about 4 P.M. Friday, Aug.11, and ended late in the afternoon of Saturday (Aug.12). The wind commenced from the N.E., and hauled gradually around to the S., the center passing about 30 miles W. of New Providence. The velocity of the wind at one time reached 90 mph and the barometer registered at its lowest 29.10 inches. The only American vessel in port (Nassau) was the steamship "Cocoa" which moved high up the harbor, kept steam up and rode out the gale in safety. The British steamer "Richmond" was also in port and escaped injury. The steam tug "Nassau" broke her moorings, drifted down the harbor and was wrecked on the reefs W. of the city (Monthly Weather Review, Aug, 1899). 52) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Aug.11, center of the cyclone was drawn to the E. of Nassau, the circulation being clearly defined by observations from Florida, Cuba and ships. Aug.12, Jupiter, wind N.E. force 6, barometer 29.74 inches; ship near lat. 28 N., long. 76.3 W., barometer 29.71 inches (Historical Weather Maps, Aug. 1899). 53) Washington, Aug.11. The West Indian hurricane tonight was rapidly approaching Nassau, where the barometer has fallen considerable since the morning and the wind has reached a velocity

of 36 mph at 5:40 P.M. There is still a possibility that the storm may curve out to sea; Weather Bureau officials now express the opinion that it will reach the Florida coast and hurricane warnings have been sent there by telegraph and telephone (The New York Times, Aug.12, 1899, p.1, col.7). 54) Washington, Aug.12 (from a statement made by the Chief of the Weather Bureau tonight). At 8:20 A.M. the observer at Jupiter reported that the hurricane began at the hour. The wind was puffy and squally and a moderately heavy sea was running. At 11:40 A.M. a bulletin was sent out indicating that the hurricane center was approaching Jupiter and hurricane signals were order displayed as far north as Charleston (The New York Times, Aug.13, 1899, p.2, col.5). 55) Jupiter, FL, Aug.12. The wind refreshed at 8 A.M. and under murky skies increased in velocity until a rate of about 40 mph was reached. At 8 P.M. tonight the speed of the wind is 38 mph. The barometer registers 29.57 inches. (The New York Times, Aug.13, 1899, p.2, col.5). 56) Key West, Aug.12. A heavy wind prevailed here all day (The New York Times, Aug.13, 1899, p.2, col.5). 57) Local weather clerk Emery (at New York) said that the lowest barometer reported last night was 29.60 inches at Jupiter. It was last night 29.80 inches at Jacksonville and 29.76 inches at Tampa and the barometer has fallen as much at both places. At Key West it was 29.72 inches (The New York Times, Aug.13, 1899, p.2, col.6). 58) The hurricane center has continued its N.W. movement and it was central last night near Jupiter, FL, this place reporting a maximum velocity of 36 mph with a pressure of 29.60 inches. Key West reported a maximum velocity of 37 mph from N.W. and Havana 24 mph from N.W. Indications favor the northward motion of the storm today over Florida, and hurricane signals are flying from Charleston southward and (around Florida) to Cedar Keys (The New York Times, Aug.13, 1899, p.2, col.6). 59) Washington, Aug.13. The West Indian hurricane appears to be gradually decreasing in strength and the chances are that it will spend before making much progress. The hurricane movement is very slow and even at Jacksonville the velocity of the wind this morning was 22 mph. The opinion of the (weather) officials is that by the time Charleston is reached the storm will have dwindled into an ordinary blow (The New York Times, Aug.14, 1899, p.1, col.7). Author's note: The actual intensity of the storm was underestimated in the above item. 60) Taken from a report by J.W. Cronk. Weather Bureau observer, Jupiter, FL: On Aug.12 the wind increased to high in the early morning and to gale by midnight, with the maximum velocity on that date being 41 mph from the N.E. at 10:45 P.M. In the early morning of Aug.13 the hurricane struck Jupiter with great force and continued blowing a gale during the day, with wind shifting to N., N.W, W., and S.W.; maximum wind velocity 52 mph from the N. at 6:20 A.M. with an extreme velocity of 63 mph. At 11:30 A.M. a wind of 51 mph was registered. Heavy rain fell in the morning and light rain in the afternoon. The barometer fell rapidly until shortly before 8 A.M., and then remained nearly stationary

until shortly before noon, when it began to rise steadily. At 8 A.M. (Aug.13) the barometer read 29.22 inches, which was within 0.04 inch of the lowest recorded reading at this station. (Monthly Weather Review, Aug.1899). 61) The schooner "Privateer" came in from down the (Florida) Keys. Monday (Aug.14). The Ball Brothers were out cruising with a friend from Chicago when the storm of last week came up. They went for a shelter behind Long Key where they put out 3 anchors and waited 60 hours for the storm to abate. They report that the wind reached a velocity of 60 mph and that the sea on the reefs was the heaviest they have ever seen (The Miami Metropolis, Aug.18, 1899, p.1, col.4). 62) The report comes from Palm Beach that the upper part of the ocean deck at the Inn was torn off during the storm of last Saturday and Sunday (Aug.12-13) and that the sea reached the ground around the Inn (The Miami Metropolis, Aug.18, 1899, p.1, col.4). 63) The steamer "Lampasas" left Key West at 9 A.M. Aug.12 and 12 hours later ran unto the gale that was blowing from the N.W. and then veered to the W. and S.W. in the Florida Straits. On that Sunday night, when the "Lampasas" got out of the Straits, the storm became worse. Towards morning (Aug.14) the wind blew with tremendous force (The New York Times, Aug.20, 1899, p.7, col.4). 64) Capt. Steven of the steamer "Havana" says that on Monday and Tuesday (Aug.14-15) when the gale was at its height we had to abandoned the course and run to the southward. On Wednesday and Thursday (Aug.16-17) a violent gale blew from the N.W. and the day following (Aug.18), the wind shifted to S.S.E. Yesterday morning the ship ran into another gale from E.S.E. (Monthly Weather Review, Aug.20, 1899, p.7, col.4). 65) The steamer "City of Macon" left Savannah Tuesday (Aug.15) around 1 P.M. A stiff wind from the N.W. was blowing and the following night the wind increased to 30 knots. A N.E. sea was running and all night the ship labored heavily. By noon on Thursday (Aug.17) it was blowing a gale at the velocity of 60 mph, and the ship shipped many seas. The "City of Macon" sighted the "Tallahassee" which had similar experiences (The New York Times, Aug.20, 1899, p.7, col.4). 66) The steamer "Alfred Dumois" came yesterday (to New York) from Santo Domingo. She left that port on Tuesday (?). Soon a storm came from the S.W. and the wind increased in intensity until Wednesday night (Aug.16). The captain had to heave for 4 hours at lat. 36 N., long. 73 W. and the hatches were battered down for 36 hours (The New York Times, Aug.20, 1899, p.7, col.4). Author's note: Aug.8 and Aug.15 were Tuesdays. The ship was at Santo Domingo on the first day because it was there on Aug.9 when the storm hit that island. Based on the content of the narrative above, the "Alfred Dumois" could not have left Santo Domingo on Aug.15 and reach the latitude of Hatteras in about one and a half days. According to information in item 37), the "Alfred Dumois" could not have left Santo Domingo earlier than Aug.12, and it seems that most likely the vessel should have left on that day or on Aug.13. 67) The following information was extracted from 8 A.M.

(E.S.T.) weather maps: Aug.13, center placed just N.E. of Jupiter. Aug.14, center placed to the E. of Jacksonville. Aug.15, several ships showing high winds were plotted. Aug.16, center was placed near lat. 33 N.,long. 75 W., circulation clearly defined by observations from land stations and several ships. Aug.17, circulation center placed near lat. 34 N., long. 73 W. Aug.18, circulation center placed almost over Hatteras, impossible to read data off the map in the vicinity of the center. Aug.19, center placed near lat. 36.5 N., long. 74.7 W. (Historical Weather Maps, Aug, 1899). 68) Extracted from maps displayed in an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: Aug.17, noon Greenwich Time, Hatteras, wind N. force 10; ship near lat. 35.5 N., long. 74 W., wind N.E. force 11; ship off Cape Lookout, wind N.W. force 8; ship near lat. 36.5 N., long. 73 W., wind E.S.E force 11; ship near lat. 36 N., long. 71.5 W., wind S.E. force 12. Aug.18, Norfolk, wind E.N.E. force 6; ship just E. of the Delmarva peninsula showing wind E. force 8; ship near lat. 37 N., long. 74.3 W., wind S.E. force 10; ship near lat. 37.3 N., long. 73.5 W., wind S.E. force 10; two ships about 60 miles to the S.E. of Cape Hatteras and Cape Lookout both showing wind S. force 10; a third ship a little to the east showing wind S. force 9. (Monthly Weather Review, Sept.1900). Author's note: Mr. Paullin stated in his article that the storm changed it course to N. by W., slowed down during Aug.16-19 to a rate of 3 mph and remained practically unchanged in area. 69) Washington, Aug.14. The West Indian hurricane has modified its intensity and is now designated as a tropical storm. It appears to be moving up to the Atlantic coast and the Weather Bureau has directed that storm warnings be extended to Atlantic City. Today at Savannah it blew 44 mph and at Charleston 40 mph; at Florida the wind fell below 15 mph (The New York Times, Aug.15, 1899, p.4, col.6). Author's note: The above statement was probably issued in the evening of Aug.14. The statement underestimated the actual intensity of the storm. 70) The lowest barometer shown in the morning report (Aug.15) was 29.62 inches at Charleston. The night report gave Wilmington as lowest with 29.66 inches (The New York Times, Aug.16, p.2, col.1). 71) The Atlantic coast storm was central last night beyond the North Carolina coast where N.E. gales prevailed yesterday, extending to the Virginia coast. Kittyhawk and Cape Henry reported a maximum wind velocity of 52 mph from the N.E. (The New York Times, Aug.,17, 1899, p.3, col.2). 72) The tropical storm approached somewhat closer to the North Carolina coast during yesterday and as a consequence dangerous gales has prevailed in that section and on the Virginia coast, moderately high winds reaching as far north as Atlantic City. Cape Henry reported a maximum velocity of 68 mph from the N.E. (The New York Times, Aug.18, 1899, p.3, col.5). 73) The indications now point to the gradual disappearance of the tropical cyclone. Pressure, however, continues low on the Virginia coast and N.E. gales are still blowing at Cape Henry (The New York

Times, Aug.19, 1899, p.2, col.6). 74) Some traces of the storm still remain on the Middle Atlantic coast. During yesterday there were high N.winds from Norfolk to Atlantic City. and the high seas also continued. The wind last night decreased, except at Atlantic City where it remained quite brisk (The New York Times, Aug.20, 1899, p.3, col.4). 75) Extracted from a report by L.N. Jesunofsky, Weather Bureau observer, Charleston: Not a casualty occurred along the coast of South Carolina during the passage of the hurricane center at close range on Aug.15-16, which may be attributed to the timely hoists of the hurricane signal, which caused vessels to seek save harbor. Fortunately the storm tides along the coast reached only 2.8 feet above normal, and the rice and the sea-island cotton crops escaped injury (Monthly Weather Review, Aug.1899). 76) Taken from a report by S.L. Dosher, Weather Bureau observer, Hatteras, N.C.: The wind began to blow a gale from the E. the morning of Aug.16, varying in velocity from 36 to 50 mph, and gradually shifting to N.E. at 6 P.M., with nearly stationary pressure. During the early morning of Aug.17 the wind, increased to a hurricane and at 4 A.M. was blowing at a rate of 70 mph; 10 A.M., it increased to 84 mph; and at 1 P.M. it was blowing 93 mph, with occasional extreme velocity of 120 to 140 mph. The record of wind after 1 P.M. was lost, but it is estimated that it blew with even greater velocity from about 3 P.M. to 7 P.M., and it is believed that between these hours the wind reached a regular velocity of at least 100 mph. The barometer began to fall rapidly about 8 A.M. Aug.17 and at 8 P.M. of that date it had reached the unprecedentedly low reading of 28.62 inches, where it remained about one hour, when it began to rise rapidly and by midnight (Aug.17-18) it had risen nearly one-half inch. From 7:30 to 8 P.M. Aug.17 there was a lull in the gale when it veered to S.E. and began to blow at an estimated velocity of 60 to 70 mph, which continued until well into the morning of Aug.18. The hurricane was the most severe in the history of Hatteras. The scene of Aug.17 was wild and terrific. By 8 A.M. the entire island was covered by water from the Sound, and by 11 A.M. all the island was covered to a depth of 4 to 10 feet. This tide swept over the island at a fearful rate carrying everything movable before it. There were not more than four houses on the island in which the tide did not rise to a depth of 1 to 4 feet; at least half of the people had to abandon their homes and seek safety with those who were fortunate enough to live on the higher grounds. The frightened people were crowded 40 or 50 in a house. All this day the gale, the tide and the sea continued with unabated fury. During the lull in the evening the tide ran off with great swiftness, causing a fall in the water of several feet in less than half an hour (Monthly Weather Review, Aug.1899). 77) On the morning of Aug.17, San Ciriaco swept over the lower banks near Diamond City. Reports of great destruction from Beaufort to Nags Head were later printed in newspapers across the country. In Carteret County, the island communities of Shackleford Banks,

Diamond City and Portsmouth were especially hard hit. Hatteras Island was devastated by the August hurricane of 1899. The Weather Bureau station in Hatteras Village was hard hit, as the entire southern end of the Outer Banks fell within the powerful right-front quadrant of the storm. The station's anemometer was blown away, and no record was made of the storm's highest winds. The barometric pressure was reported as near 26 inches which, if accurate, would suggest that the San Ciriaco hurricane may have reached category-five intensity. The great hurricane of '99 scuttled or sank many ships from Wilmington to the Virginia line. In his book Graveyard of the Atlantic, author David Sticks lists 7 vessels that were wrecked on the North Carolina coast during the storm: "Aaron Reppard", "Florence Randall", "Lydia Willis", "Fred Walton", "Robert W. Dasey", "Priscilla", and "Minnie Bergen". Also the Diamond Shoals Lightship was driven ashore after its mooring lines were broken by the storm's mountainous seas. Six other ships were reported lost at sea without a trace: "John C. Haynes", "M.B. Millen", "Albert Schultz", "Elwood H. Smith", "Henry B. Cleaves", and "Charles M. Patterson" (Barnes, 1995). Author's note: The pressure reading near 26 inches seems to be the product of speculation. The facts that Hatteras experienced a minimum pressure of 28.62 inches and a lull in the evening of Aug.17 do not support such an extremely low pressure. 78) Extracted from an article by C.O Paullin, Nautical Expert, United States Hydrographic Office: Plotted data on a weather map for noon Greenwich time Aug.19 included ship near lat. 36 N, long. 74.7 W., wind S.W. force 8; ship near 37.3 N., 74.7 W., wind N.E. force 6; ship near lat. 35 N., long. 75 W., wind S.W. force 8; ship near lat. 37 N., long. 73.3, wind S. force 8; ship near lat. 38 N., long. 74 W., wind E.S.E. force 8; Norfolk, wind N. force 4. Plotted data on a weather map for noon Greenwich time Aug.20 included ship reports near lat. 38.5 N., long. 71.5 W. Ship at about lat. 38 N., long. 71.3 W. showed wind S.W. force 4; ship near lat. 38.5 N. long. 72. W. showed wind N. force 7; ship near lat. 36.5 N. long. 70.5 W., showed wind W. force 6; ship near lat. 36.5 N., long. 72.7 W, showed wind N.W. force 10; ship near lat. 40 N., long. 71.5 W. showed wind N.E. force 5; ship near lat. 39.5 N; long. 69.5 W showed wind S.S.E. force 4; ship near lat. 39.5 N, long. 68 W, showed wind S.S.E force 6 (Monthly Weather Review, Oct.1900). 79) Information taken from 8 A.M. (E.S.T.) weather maps: Aug.20, center placed near lat. 38.5 N., long. 69.5 W. Aug.21, center placed near lat. 39.7 N., long. 63.7 W., circulation fairly well defined by ship observations. Aug.22, cyclone became extratropical, center near lat. 39 N., long. 54 W.; ship near lat. 41 N., long. 52 W., wind E. force 8, barometer 29.77 inches; ship near lat. 37 N., long. 54 W., wind S.W. force 7, barometer 29.80 inches. Aug.23, ship near lat. 36 N., long. 50 W., wind W. force 9, barometer 29.74 inches; occluded low to the E.N.E. and distant from the ship; trough oriented E.N.E.-W.S.W; several ships with wind N.E. force 6-

8 to the north of trough (the cyclone was probably embedded in the trough and central near lat. 37 N., long. 50 W.). Aug.24, no data; center of the occluded low near lat. 34 N., long. 46 W. Aug.25, ship near lat. 32 N., long. 42 W, wind W.S.W. force 6, barometer 29.91 inches; center of the low near lat. 36 N., long. 43 W. Aug. 26, ship near lat. 37.5 N., long. 42 W., wind E.S.E force 8, barometer 29.91 inches; center of the low near lat. 36 N., long. 44 W.; high to the north near lat. 45 N., long. 45 W. Aug.27, ship near lat. 37 N., long. 45.5 W, wind W. force 8, barometer 29.83 inches; center of the low near lat. 38.5 N. long. 44.5 W. Aug.28, ship near lat. 41 N., long. 49 W, wind N. force 6; ship near lat. 39 N., long. 49 W., wind N. force 6; ship near lat. 40.7 N., long. 43 W., wind S.S.E. force 9 (pressure could not be read off the map); center of the low near lat. 40 N., long. 45 W. Aug.29, ship near lat. 37 N., 45.5 W., wind N. force 6, rain; ship near lat. 43 N., long. 41 W., wind E. force 5, rain ; ship near lat. 40.5 N., long. 38 W., wind S. force 4; ship near lat. 40 N., long. 46.5 W., wind N.N.W. force 6 (pressure could not be read off the map); center of the low near lat. 40.5 N., long. 42.5 W. Aug.30, ship near lat. 41.5 N., long. 43 W., wind N.E. force 6; ship near lat. 37 N., long. 41 W., wind W.S.W. force 2, barometer 29.86 inches; ship near lat. 36 N., long. 40.5 W., wind W.S.W. force 5; center of the low near lat. 40 N., long. 42 W. Aug.31, ship near lat. 40.5 N., long. 38 W., wind E. force 6, barometer 29.94 inches; ship near lat. 37.5 N., long. 40.7 W., wind W. force 7, barometer 29.94; center of the low near lat. 40 N., long. 40 N., although near lat. 39 N., long. 40 W. seems to be a more realistic location (Historical Weather Maps, Aug. 1899). 80) Information extracted from 8 A.M. (E.S.T.) weather maps: Sept.1, low center near lat. 40 N., long. 37 W.; several ships showed N.E. and N. winds, the maximum velocity being force 5; 3 ships showed S.W. winds, the maximum velocity beinf force 5; temperatures reported were in the middle and low 70's; no fronts were drawn in association with the low. Sept.2, ship near lat. 39.5 N., long. 34.5 W., wind N.E. force 7; ship near lat. 37.3 N., long. 38.7 W., wind N.W. force 7, barometer 30.00 inches; ship near lat. 37.7 N., long. 31.0 W., wind S.W. force 9, barometer 29.86 inches; Ponta Delgada (Azores), wind S.W. force 2, barometer 30.01 inches; Horta (Azores), wind S. force 2, barometer 29.99 inches; center of the low near lat. 39 N., long. 31 W. Sept.3, Horta (Azores), wind S.E. force 8, barometer 29.69 inches; center of the low near lat. 37 N., long. 28 W.; some ships around the low showing maximum winds force 5-6; temperatures near the middle 70's. Sept.4, ship near lat. 49.5 N., long. 16 W., wind N. force 6, barometer 29.68 inches; ship near lat. 48.5 N., long. 15 W., wind S. force 6, barometer 29.50 inches; ship near lat. 48.7 N., long. 18 W., wind N. force 8, barometer 29.59 inches; ship near lat. 48.5 N., long. 12.5 W., wind S. force 5, barometer 29.77 inches; center of the low near lat. 49 N., long. 15.5 W., clearly defined by ship observations; cool air around the low, temperatures

in the mid and upper 60's. Sept.5, occluded, extratropical low near lat. 64 N., long. 9 W., with front passing near lat. 50 W., long. 10 W. (Historical Weather Maps, Sept.1899). 81) Taken from an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: During the week of Aug.24-30 the storm remained almost stationary near the 45 degrees W. parallel, the center on Aug. 26-28 shifting westward and northward. To the east of the Azores the storm moved northeastward, bending to the southward near 5 degrees W. meridian (Monthly Weather Review, Oct. 1900). Author's note: A map which accompanies the article, shows that the storm described a trajectory similar to a letter S over the period Aug.24-30. 82) Also taken from the article by C.O. Paullin; San Miguel (Ponta Delgada), Azores had a barometric reading of 29.08 inches. The storm at this island caused much damage to property, besides with the reported loss of life (Monthly Weather Review, Oct.1900). Author's note: A barograph trace accompanies the article, showing a quite sharp drop in pressure from about 750 millimeters (29.53 inches) at 11 A.M. (presumably local time) to about 737 millimeters (29.02 inches) around 2:40 P.M. Sept.3, then rising to 750 millimeters (29.53 inches) by 6 P.M. Wind directions were plotted on the graph, showing that the wind blew from S.S.E. first, then shifting to S.W and N.W. and finally to N. The graph was furnished the Hydrographic Office through the courtesy of Capt. F.A.Chaves, director of the Meteorological Observatory at Ponta Delgada, San Miguel, Azores. The minimum pressure shown in the graph was slightly lower than the one of 29.08 inches previously given in the text. The storm apparently passed almost over Ponta Delgada, slightly to the northward. 83) Ponta Delgada, Azores, Sept.3. A violent cyclone is at the present raging here. The Portuguese barque "Helena" dragged her anchor and sank, the crew jumping overboard. The cyclone is accompanied by excessively heavy rain and great damage has been done all over the island. Many houses in which pineapples were cultivated are completely wrecked, several roads are interrupted and many telegraph poles are blown down (The Times, London, Sept.4, 1899, p.4, col.3). 84) Ponta Delgada, Azores Islands, Sept.3. A violent storm is raging here, doing much damage to shipping and to property all over the island of St. Michael. Several lives have been lost (The New York Times, Sept.4, 1899, p.7, col.3). 85) Taken from an article by C.O. Paullin, Nautical Expert, U.S. Hydrographic Office: The log of the French steamship "Chateau Lafitte", which vessel met the storm on Sept.6 in lat. 46 N., long. 8 W., shows that on that date it has but little of the severity which it exhibited within the tropics. The "Chateau Lafitte" reports: "At noon the wind blew almost a hurricane from the S.W.; sea very heavy from the same direction, barometer 29.50 inches" (Monthly Weather Review, Oct.1900). 86) Information extracted from 8 A.M. (E.S.T.) weather maps: Sept.6, ship near lat. 46 N., long. 12 W., wind N.W. force 6, barometer 29.62 inches;

ship near lat. 47 N., long. 7 W., wind S. force 8; ship near lat. 49 N. long. 10 W., wind N.E. force 5, barometer 29.94 inches; center of a low pressure area near lat. 47 N., long. 9 W. (Historical Weather Maps, Sept. 1899). 87) Taken from the above mentioned article by C.O. Paullin: On Sept. 9 it (the storm) was central off the coast of Provence, France. Gales prevailed in this region until Sept.12, on which date the storm apparently had united with an area of low barometer covering southeastern Europe (Monthly Weather Review, Oct.1900). Author's note: Provence is located on the Mediterranean coast of France. 88) 1899. The great hurricane of this year was the one that occurred in Aug.7-14. It was so violent and caused such widespread destruction that it will certainly be ranked as a historical hurricane... Suffice to say then, that the wreckage along its path is comparable only to "the gambols of a bull in a china store". The hurricane was peculiar in that it maintained a distinct organized existence for more than one month, finally dissipating in the region of the Mediterranean Sea (Garriott, 1900). 89) Some maximum wind velocities were as follow: San Juan, E. 66 mph on Aug.8; Key West, N.W. 38 mph on Aug.13; Jupiter, N. 52 mph on Aug.13; Savannah, N.E. 44 mph on Aug.14; Charleston, N.E. 57 mph on Aug.15; Wilmington, N.E. 36 mph on Aug.16; Norfolk, N.E. 42 mph on Aug.17; Cape Henry N.E. 66 mph on Aug.17 (Monthly Weather Review, Aug. 1899). 90) Storm of Aug.3-Sept.8, 1899. Cape Verdes, Puerto Rico, recurved off the Atlantic coast. Disastrous at Puerto Rico. Skirted South Atlantic coast; at Hatteras was most violent storm in the memory of oldest inhabitants. (Tannehill, 1938). Author's note: Tannehill (1938) also shows a track for this storm. Such a track exhibited a motion describing a letter "S" in the middle of the Atlantic Ocean, roughly within the area limited by the 37 and 41 degrees N. parallels and the 47 and 40 degrees W. meridians over the period Aug.23-29. the storm then continuing to the Azores Islands on an E.S.E. track. This partial track of the storm is similar to the one shown in the article by C.O. Paullin (item 81). 91) Storm of Aug.12-19, 1899. Minor on the East coast of Florida; very severe offshore. Extreme at Cape Hatteras, N.C.; 7 ships wrecked. Coast of Va., Del. and N.J. Minor; storm center off the coast (Dunn and Miller, 1900). 92) Map showing a partial track for the storm covering the period Aug.7-15. Morning positions read off the tracks were: Aug.7, to the N.E. of Dominica and E.S.E. of Guadeloupe; Aug.8, off the southern coast of Puerto Rico to the S.E. of Ponce (this position appears to be slightly to the S. and W. of the actual one); Aug.9, on the northern coast of the Dominican Republic near Puerto Plata; Aug.10, over the eastern coast of Grand Inagua Island; Aug.11, to the S.W. of Long Island and to the S. of Great Exuma Island; Aug.12, near the eastern coast of Andros Island; Aug.13, about 40 miles to the E.S.E. of Jupiter; Aug.14, near lat. 29 N., long. 80 W., Aug.15, near lat. 31.5 N., long. 80.3 W. A map showing a second track along which the following morning positions

were estimated: Aug.12, near lat. 26 N., long. 78 W.; Aug.13, near lat. 26.7 N., long. 79.7 W.; Aug.14, near lat. 29.5 N., long. 80 W.; Aug.15, near lat. 32.5 N., long. 79 W.; Aug.16, near lat.33.7 N., long. 76.7 W.; Aug.17, near lat. 34.5 N., long. 76 W.; Aug.18, near lat. 35.5 N., long. 75.7 W.; Aug.19, near lat. 37 N., long. 74.7 W.; Aug.20, near lat. 40 N., long. 71 W. (Monthly Weather Review, Aug.1899). 93) An Aug.1899 storm appeared near lat. 16 N., long. 60 W., recurred near lat. 27 N., long. 80 W. and disappeared S. od Nova Scotia. Map showing a track for the storm to the east of Dominican on Aug.7; just off the S.E. tip of Puerto Rico on Aug.8; just a few miles off the northern coast of Hispaniola near the 70 degrees W. meridian on Aug.9; just E. of Great Inagua Island (Bahamas) on Aug.10; near lat. 22.5 N., long. 75.5 W. or to the S.W. of Long Island (Bahamas) on Aug.11; about 45 miles S. of Nassau on Aug.12; about 45 miles to the E.N.E. of Jupiter on Aug.13; near lat. 29.5 N., long. 80 W. on Aug.14; about 60 miles to the S.E. of Charleston on Aug.15; near Cape Lookout on Aug.16 (Garriott, 1900). 94) A storm was first observed near lat. 12 N., long. 36 W. on Aug.3, 1899 and lasted 36 days; it recurved near lat. 29 N., long. 81 W. and it was last observed near lat. 46 N., long. 2 E. (Mitchell, 1924). Author's note: A track which is also included in Mitchell (1924) was found to be quite similar to the one in Neumann et al. (1993) as for Storm 2, 1899. However, while the latter authors ended their track over the northern Atlantic on Aug.24, Mitchell (1924) continued his track to France, having the storm to cross the entire northern Atlantic after describing a track similar to a letter "S" at midocean. In that sense, the track in Mitchell (1924) is closer to the one shown by C.O. Paullin in the Monthly Weather Review, Oct. 1900 than to the one in Neumann et al. (1993).

On the basis of information in the above items, the author of this study decided to introduce some modifications along the storm track given in Neumann et al. (1993) as for Storm 2, 1899 and to extend such a track eastward into the eastern Atlantic Ocean. A careful analysis of the observations taken by the "Grangense" (item 1) and ship information for Aug.3 in item 2) allowed the author of this study to adjust eastward the 7 A.M. Aug.3 position in Neumann et al. (1893) by about 120 miles to near 12.0 degrees N., 34.0 degrees W. The above mentioned adjustment suggested the need for an adjustment in the 7 A.M. Aug.4 position in Neumann et al. (1993) in order to keep space-time continuity along the track; this adjustment was made, resulting in the author's 7 A.M. Aug.4 position near 12.7 degrees N., 40.3 degrees W., which was found to be about 50 miles to the E. of the corresponding position in Neumann et al. (1993). The 7 A.M. Aug.5 position in Neumann et al. (1993) was found to keep a good space-time continuity with their 7 A.M. Aug.6 position for which some support could be derived from a ship observation for that day (item 2). In addition, meteorological

information contained in items 2) through 32) was found to support the 7 A.M. positions for Aug.7 and Aug.8 shown in Neumann et al. (1993). Consequently, 7 A.M. positions for the period Aug.5-8 in the above mentioned publication were kept unchanged. The 7 A.M. Aug.9 position in Neumann et al. (1993) was adjusted a few miles to the N.E. to near 19.7 degrees N. 69.7 degrees W. in order to fit a better space-time continuity with the author's position for next day, and at the same time to keep the center of the storm moving along the N.E. coast of the Dominican Republic having barely touched at Cape Samana and Cape Frances Viejo but definitively avoided the hilly terrain to the east of Puerto Plata as suggested by the track in item 93). The author's 7 A.M. Aug.10 position was estimated near 21.0 degrees N., 73.0 degrees W. on the basis of an analysis of information in items 39) through 41), 43), 92) and 93). This position was found to be about 40 miles to the N.E. of the one shown in Neumann et al. (1993). The author's 7 A.M. Aug.11 position was estimated near 23.0 degrees N., 76.0 degrees W. on the basis of an analysis of information in items 42), 52), 53), 92) and 93). This position was found to be about 50 miles to the N.N.E. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.12 position was estimated near 24.5 degrees N., 78.0 degrees W. on the basis of information contained in items 48) through 52), 92) and 93), although the position along the second track in item 92) was discarded; this position was found to be about 50 miles to the E.S.E. of the corresponding position in Neumann et al. (1993). 7 A.M. positions for Aug.13-14 in Neumann et al. (1993) were found to be supported by information contained in some of the above items, and, therefore, were kept unchanged; however the 7 A.M. Aug.15 position in their publication was slightly adjusted to the S.E. to near 31.7 degrees N. 78.7 degrees W. in order to fit a better space-time continuity with the author's position for next day. The author's 7 A.M. Aug.16 position was estimated near 33.0 degrees N., 75.5 degrees W., primarily on the basis of information for that day contained in item 67); this position was found to be about 80 miles to the E. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.17 position was estimated near lat. 34.5 N., long. 74.5 W. on the basis of an analysis of information in items 67), 68) and 76); this position was found to be about 60 miles to the E.N.E. of the corresponding one shown in Neumann et al. (1993). The 7 A.M. Aug.18 position in Neumann et al. (1993) was kept unchanged because it was found to be supported by information contained in several items, particularly in item 68). The author's 7 A.M. Oct.19 position was estimated near 36.5 degrees N., 74.7 degrees W. on the basis of information for that day contained in items 67) and 78); this position was found to be about 90 miles to the S.W. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.20 position was estimated near 38.7 degrees N., 71.0 degrees W. and was based on information for that day in items 78) and 79); such a position was found to be

slightly to the S.W. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. positions for the period Aug.21-24 were as follows: Aug.21, near 39.7 degrees N., 63.5 degrees W.; Aug.22, near 38.7 degrees N., 54.3 degrees W.; Aug.23, near 36.7 degrees N., 50.0 degrees W.; Aug.24, near 34.3 degrees N., 46.0 degrees W. The above positions were based on information for the respective days in item 79) and were found to be about 40 miles to the N., about 180 miles to the E.N.E., a few miles to the S. and about 140 miles to the S. W. of the corresponding positions in Neumann et al. (1993). The author of this study decided to extend the track in Neumann et al. (1993) beyond Aug.24 on the basis of information in items 79) through 84). By using information in item 79), he estimated the following 7 A.M. positions for the period Aug.25-31: Aug.25, near 35.3 degrees N., 43.0 degrees W.; Aug.26, near 36.5 degrees N., 43.5 degrees W.; Aug.27, near 37.7 degrees N., 44.5 degrees W.; Aug.28, near 40.0 degrees N., 45.0 degrees W.; Aug.29, near 40.5 degrees N., 43.0 degrees W.; Aug.30 near 40.3 degrees N., 41.5 degrees W.; Aug.31, near 40.0 degrees N., 40.0 degrees W.; the above positions resulted in a track describing a letter "S" which. in a sense, was similar to the ones presented by C.O. Paullin (item 81), Tannehill (item 90) and Mitchell (item 94), although it differed from those in details pertaining to times of storm positions and to the actual shape of the letter "S". On the basis of information in item 80), the author of this study estimated positions near 40.0 degrees N., 37.0 degrees W. for 7 A.M. Sept.1 and near 39.0 degrees W., 32 degrees W. for 7 A.M. Sept.2. The author's 7 A.M. Sept.3 position was estimated near 37.3 degrees N., 28.7 degrees W., and was based on an analysis of meteorological information for the Azores Islands (items 80 and 82). The author of this study decided to terminate his track for Storm 3, 1899 in the vicinity of 39.0 degrees N., 24.0 degrees W. because of uncertainties about the evolution followed by the storm after the storm center passed practically over Ponta Delgada (item 82). On one hand, there is a strong likelihood that the storm had accelerated to the N.E., being the low pressure center located near 49.0 degrees N., 15.5 degrees W. on the morning weather map for Sept.4 (item 80); that system seemed to have been absorbed in the circulation of the huge extratropical cyclone which was located near 64.0 degrees N., 9 degrees W. on Sept.5 (item 80). On the other hand, C.O.Paullin stated that the storm was encountered by the "Chateau Laffite" at 46.0 degrees N., 8.0 degrees W., on Sept.6 (item 85), that it bent southward near the 5.0 degrees W. meridian (item 81) and that it was central off the coast of Provence (France) on Sept.9 (item 87). Meteorological information for Sept.6 in item 86) confirms the existence of the storm encountered by the "Chateau Lafitte" (item 85) but, in the author's opinion, this storm was unrelated to the one which passed over Ponta Delgada on Sept.3 (item 82) and probably developed along the frontal boundary which passed through 50.0 degrees N., 10.0 degrees W. on the

morning map of Sept.5 (item 80). However, the author of this study could not produce any evidence which entirely disproved any relationship between the two storm. This was the reason he had for terminating his track on Sept.3 and, by so doing, he avoided the risk of having introduced a portion of the track which was never described by Storm 3, 1899. The author's track for the storm is displayed in Fig.2.

The hurricane status which Neumann et al. (1993) gave to this storm as for Storm 2, 1899 was confirmed by information contained in many of the items above. Pressures well below 28.50 inches, reaching as low as 27.45 inches at Monserrat (item 7) and 27.75 inches at Puerto Rico (item 24) clearly indicate that the storm was a major hurricane which attained great intensity in the Caribbean Islands. The classification of the storm as extreme in the Hatteras area given by Dunn and Miller (item 91) indicates that the storm attained great intensity on the North Carolina coast as well. Late on Aug.5, Neumann et al. (1993) introduced hurricane status along their track; the author of this study found this to be reasonable and decided to start denoting hurricane intensity along his track in the vicinity of 14 degrees N., 49 degrees W. as the above mentioned authors did. The hurricane status was kept along the author's track until the storm reached the vicinity of 40 degrees N., 60 degrees W.,late on Aug.21. A change to an extratropical stage was introduced on Aug.22 as fronts were drawn in association with the cyclone on the morning map corresponding to that day, declaring the storm extratropical (item 79); however, an observation taken a by ship on the morning of Aug.23 still suggested the fairly tight wind structure which is typical of tropical cyclones. No fronts were drawn in connection with the cyclone on the map corresponding to Aug.26 and the author decided to replace the extratropical stage with that of a tropical storm on that day; the reasoning behind so doing was that the extratropical stage of the storm had been probably overestimated and that the system had started to move northward, approaching the warmer waters of the Gulf Stream. The tropical storm status was changed to a hurricane on the basis of the lowest pressure of 29.02 inches at Ponta Delgada (item 82), the tight pressure gradients which were inferred from a barograph trace (item 82) and the damage done on the island of San Miguel Azores (items 83 and 84). Hurricane intensity was maintained until the author's track for Storm 3, 1899 was terminated in the vicinity of 39 degrees N., 24 degrees W. late on Sept.3.

Storm 4, 1899 (Aug.29-Sept.8), H.

This storm corresponds to Storm 3, 1899 in Newmann et al. (1993).

The following information was found about this storm: 1) This disturbance was of moderate strength throughout a course which lay from a point E. of Guadeloupe on Aug.29 to a position S. of Santo Domingo on Aug.31, thence N.W. and N. over western Haiti, and thence N.E. to the vicinity of Bermuda Islands by Sept.4. Shipping and other interests were advised of the approach and character of this disturbance and precautions which were justified by reports. It appears that while the storm possessed but moderate intensity over the Caribbean Sea, Santo Domingo and Haiti it acquired greater strength after it recurved northward and northeastward over the ocean (Monthly Weather Review, Sept. 1899). 2) The tropical storm central E. of the island of Guadeloupe is moving N. by W. This storm has not yet developed dangerous force but all the interested parties throughout the West Indies have been notified of the facts and advice given that shipping interest should take all necessary precautions (The New York Times, Aug.30, 1899, p.2, col.7). Author's note: This statement was probably issued in the evening of Aug.29. 3) The tropical storm is tonight (Aug.30) central in the Middle Caribbean Sea, S. of San Juan, moving W.N.W. It has increased in energy since Tuesday night (Aug.29) and the following maximum velocities and reported: Santo Domingo 24 mph from S.E., St. Kitts 30 mph from S.E., San Juan 32 mph from E. (The New York Times, Aug.31, 1899, p.2, col.7). 4) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Aug.29, Dominica, wind S.W. force 1, barometer 28.88 inches; Barbados, wind S. force 2, barometer 29.88 inches, two ships near the extreme N.E. Leeward Islands showing winds from E.N.E. force 5. Aug.30, St. Kitts, wind E. force 6, barometer 29.81 inches; Antigua (or ship nearby), wind E.S.E. force 7; St. Thomas (or ship nearby), wind E. force 4 (pressure could not be read off the map); San Juan, wind N.E. force 3, barometer 29.89 inches; Dominica, wind S.E. force 1, barometer 29.86 inches. Aug. 31, Santo Domingo, wind N. force 3, barometer 29.85 inches; St. Kitts, wind E. force 4, barometer 29.92 inches; Kingston, wind N.E. force 3, barometer 29.87 inches; ship near lat. 17.2 N., long. 75.5 W., wind N.E. force 5, barometer 29.94 inches (probably too high); ship near lat 15.5 N. long 67 W., wind S. force 11, barometer 29.77 inches (Historical Weather Maps, Aug. 1899). Author's note: The 8 A.M. (E.S.T.) Aug. 31, 1899 map placed the storm center near lat. 15.5 N., long. 70 W., a position which seems to be too far west. 5) Kingston, Jamaica, Aug 31. The storm is to the S. of Santo Domingo and moving to Jamaica, where it is expected on Saturday, Sept. 2 (The Times, London, Sept. 1, 1899,

p.4, col. 3). 6) The tropical storm has moved to the S.W. of Santo Domingo, It showed a slight further increase in intensity. San Juan reported a maximum wind velocity of 48 mph from the S.W. and St. Kitts 28 mph from S.E. (The New York Times, Sept.1, 1899, p.2, col.7). Author's note: This statement was probably issued the evening before its publication date. The S.W. wind direction at San Juan seemed to be either a typographic error or the result of local thunderstorm activity. 7) The month (Sept. 1899) opened with a tropical cyclone S.E. of Santiago de Cuba. Advisory information regarding the disturbance was received at the West Indian forecast district (Havana) the evening of Aug.31. The following message was received from Washington the evening of Sept.1: "Storm center 4 P.M. S. and near Santiago de Cuba, moving W.N.W.; slightly increased energy. Vessels sailing from Cuban ports and those W. from Santo Domingo and Haiti should take every precaution". This information was telegraphed to all regular and display stations on the Island of Cuba and to Santo Domingo, and to all newspapers that could be reached. At 1:44 P.M. Sept.2 the following was received from Washington: "Tropical storm near Windward Passage; continued strong N.E. winds on Florida and north Cuban coasts for a day or two; high seas". The following was received from Washington at 9 P.M. (Sept.2): "Storm apparently recurved and centered N. of Santo Domingo and Haiti, moving northward; little energy. Caution advised vessels sailing in that direction; stations notified" (Monthly Weather Review, Sept. 1899). Author's note: The above information was taken from the report of the West Indian forecast district office of the Weather Bureau (Havana) which is included in the Monthly Weather Review (Sept. 1899). Versions of the evening weather statements of Sept.1 and Sept.2 were also published in The New York Times, Sept. 2, 1899, p.2, col.7 and in The New York Times, Sept. 3, 1899, p.3, col.7, respectively. 8) The tropical storm recurved near the Windward Passage on Saturday (Sept.2) and moved up to the N.without developing a force of consequence, and during yesterday the barometer rose throughout the West Indies, except over western Cuba (The New York Times, Sept.4, 1899, p.2, col.6). Author's note: Information contained in the next item, clearly indicates that the storm had reached hurricane intensity by Sept.3; therefore, the statement "without developing a force of consequence" was found to have seriously underestimated the actual intensity of the storm at its time of issuance, which was probably in the evening of Sept.3. 9) Observations taken on the U.S. transport "Kilpatrick" on Sept.3, when in about lat. 25 N., long. 68 35 W., show that hurricane winds were encountered in that position (Monthly Weather Review, Sept.1899). 10) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Sept.1, Santiago de Cuba, wind N. force 4, barometer 29.78 inches; Port-au-Prince, wind E. force 3, barometer 29.73 inches; Santo Domingo, wind N.E. force 1; San Juan, wind S.E. force 2, barometer 29.90 inches; ship near lat. 20 N., long. 70 W., wind S. force 5,

barometer 29.86 inches; ship near lat. 16 N., long. 74.5 W., wind N.N.W. force 2. Sept.2, Port-au-Prince, wind N.W. force 2, rain, barometer 29.74 inches; Santo Domingo, wind W, force 2, rain, barometer 29.75 inches; Santiago de Cuba, wind N. force 2, barometer 29.77 inches; Kingston, wind N.N.E. force 2, barometer 29.80 inches; ship near lat. 23 N., long. 74 W., wind E., force 5, barometer 29.71 inches. Sept.3, Port-au-Prince wind; N.W. force 2, barometer 29.82 inches; Santo Domingo, wind S.W. force 2, barometer 29.81 inches (not clearly read off the map.); San Juan, wind S.E. force 2, barometer 29.86 inches; ship near Caicos, wind N.N.E. force 2, barometer 29.71 inches; ship near lat. 25.3 N., long. 73.5 W., wind N.N.E. force 2; ship near lat. 25 N., long. 67.5 W., wind S.E. force 10 (barometer could not be read off the map); ship near lat. 26 N., long. 66 W., wind E. force 7. Sept.4, ship near lat. 30 N., long. 69 W., wind N.E. force 9; ship near lat. 30 N., long. 63.7 W., wind S.S.E. force 10; storm center shown on the 8 A.M. (E.S.T.) Sept.4, 1899 map at lat. 29.5 N., long. 67.5 W. Sept.5, extratropical low shown near lat. 35.5 N., long. 59.5 W. on the corresponding map for that day (Historical Weather Maps, Sept. 1899). 11) Winds of hurricane force blew over Bermuda in a 12 hours storm on Sept.4, 1899, doing considerable damage (Tucker, 1982). Author's note: Tucker (1982) believes that this hurricane occurrence was one of the reasons the inhabitants of the island did not prepare for a second hurricane which affected Bermuda on Sept.12-13, 1899. She stated that "the inhabitants had only caught their breath after it when this second, and far more lethal, one struck". 12) Storm of Aug.29-Sept.10, 1899. Puerto Rico, Bahamas (Tannehill, 1938). Author's note: It should be mentioned that Salivia (1972) does not mention this storm as having seriously affected Puerto Rico, and that only the S.E. Bahamas felt the effects of the storm. 13) Map showing a track for the storm. The following morning positions were extracted from the map: Aug.30, near lat. 15.3 N, long. 63.5 W.; Aug.31, near lat. 16.7 N., long. 70.5 W.; Sept.1, near lat. 18.7 N., long.73.3 W.; Sept.2, near lat. 20.7 N., long. 73.5 W.; Sept.3, near lat. 24.5 N., long. 71.5 W.; Sept.4 near lat. 29.5 N., long. 67.7 W., having the storm passed just to the N.W. of Bermuda later on that day (Monthly Weather Review, Sept.1899). 14) Map practically reproducing the same track which was published in the Monthly Weather Review, Sept.1899 and described in the item above (Garriott, 1900). 15) A storm was first observed at lat. 16 N., long. 58 W. on Aug.29, 1899 and lasted 16 days; it recurved at lat. 22 N., long. 72 W and it was last observed at lat. 65 N., long. 13 W. (Mitchell, 1924). Author's note: A track for this storm which is included in Mitchell (1924) was found to bring the storm over the N.E. tip of Puerto Rico and then to the north of Hispaniola. This track was found to be quite similar to the one in Neumann et al. (1993); however, it was found to be very different from the tracks in items 13) and 14).

After having carefully examined the content of items 1) through 14), the author concluded that a major modification of the storm track in Neumann et al. (1993) was necessary for the period Aug.30-Sept.5, and that the modification to be implemented for the first half of such a period was so dramatic that it was preferable to prepare an entirely new track. After having kept unchanged the 7 A.M. Aug.29 position in Neumann et al. (1993) because it was found to fit a good space-time continuity as applied backwards from the first position estimated by the author of this study, the following 7 A,M, positions were estimated by him: Aug.30, near 16.7 degrees N., 63.0 degrees W., primarily on the basis of the morning observation taken at St. Kitts on that day (item 4); this position was found to be 70 miles to the S.W. of the corresponding one in Neumann et al. (1993). Aug.31, near 16.5 degrees N., 68.0 degrees W., primarily on the basis of the morning observation provided by a ship, having reported a wind S. force 11 in the eastern Caribbean Sea on that day (item 4); this position was found to be about 200 miles to the S.W. of the corresponding one in Neumann et al. (1993). Sept.1, near 17.5 degrees N., 72.0 degrees W., primarily on the basis of meteorological morning reports from Port-au-Prince which showed the lowest pressure of 29.73 inches with a wind E. force 3 and a ship in the central Caribbean Sea, which showed a wind N.N.W. force 2 on that day (item 10); this position was found to be about 200 miles to the S.W. of the corresponding one in Neumann et al. (1993). Sept.2, near 20.7 degrees N., 71.7 degrees W., based on mornings meteorological observations for that day (item 10); this position was found to be about 80 miles to the S. of the corresponding one in Neumann et al. (1993). Sept.3, near 24.5 degrees N., 70.0 degrees W., primarily on the basis of meteorological information provided by ships in the vicinity of lat. 25 N., and between long. 66 and 67.5 W. in the morning of that day (item 10) and by the "Kilpatrick: (item 9) and, to a lesser extent, by the remaining data for Sept.3 which are contained in item 10); this position was found to be about 120 miles to the S.S.E. of the corresponding one in Neumann et al. (1993). Sept. 4, near 29.5 degrees N., 67.5 degrees W., based on morning meteorological information for that day (item 10); this position was found to be about 80 miles to the S.E. of the corresponding one in Neumann et al. (1993), and later on Sept.4 the storm center was made to pass just to the N.W. of Bermuda as supported by track information in items 13) and 14). Sept.5, near 35.5 degrees N., 59.5 degrees W., based on information for the morning of that day contained in item 10); this position is roughly 120 miles to the east of the corresponding one in Neumann et al. (1993). 7 A.M. positions for the period Sept.6-8 in the above publication (as for Storm 3, 1899) were kept unchanged. The author's track for Storm 4, 1899 is displayed in Fig.2.

The hurricane status which Neumann et al. (1993) attributed to

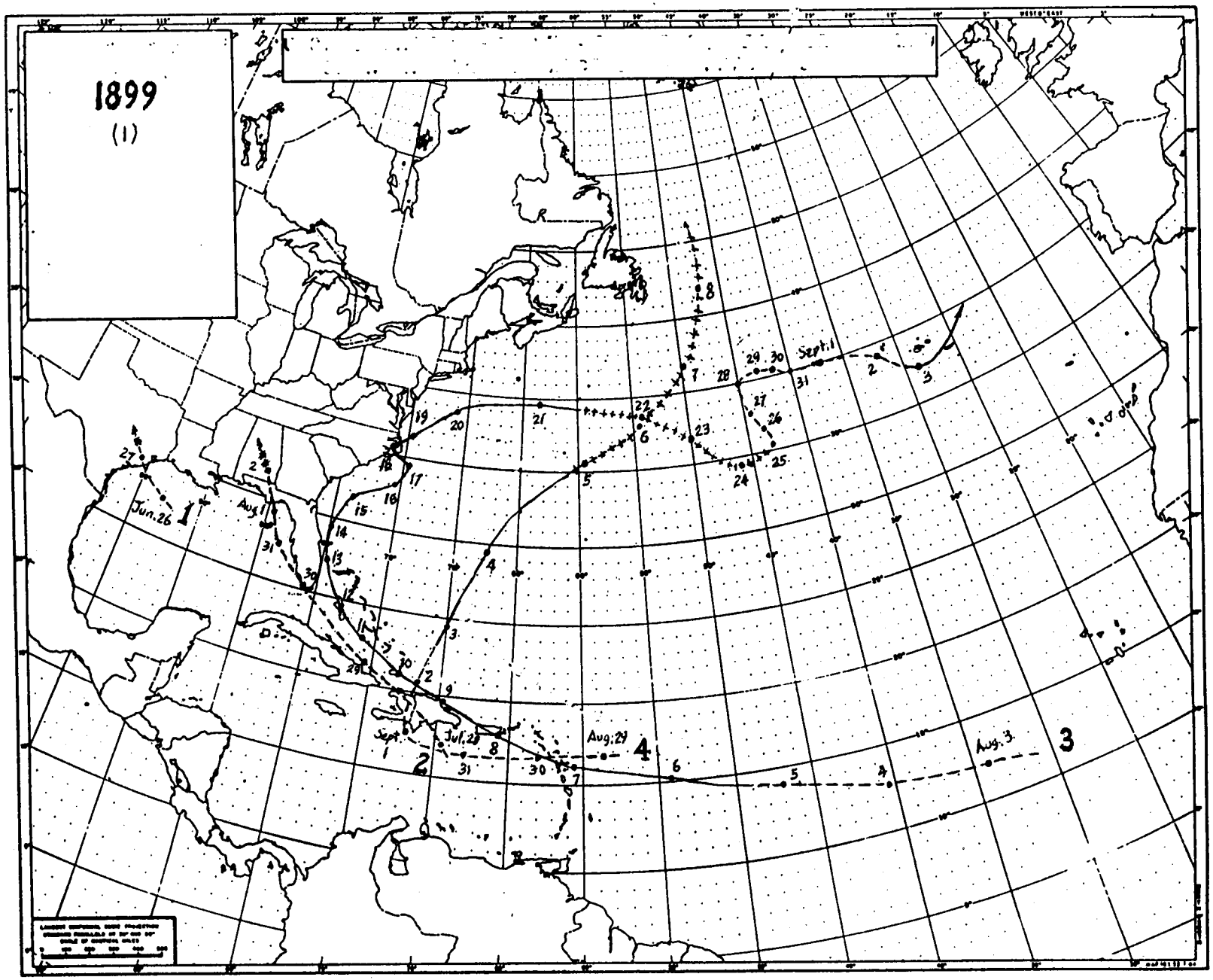

Fig. 2

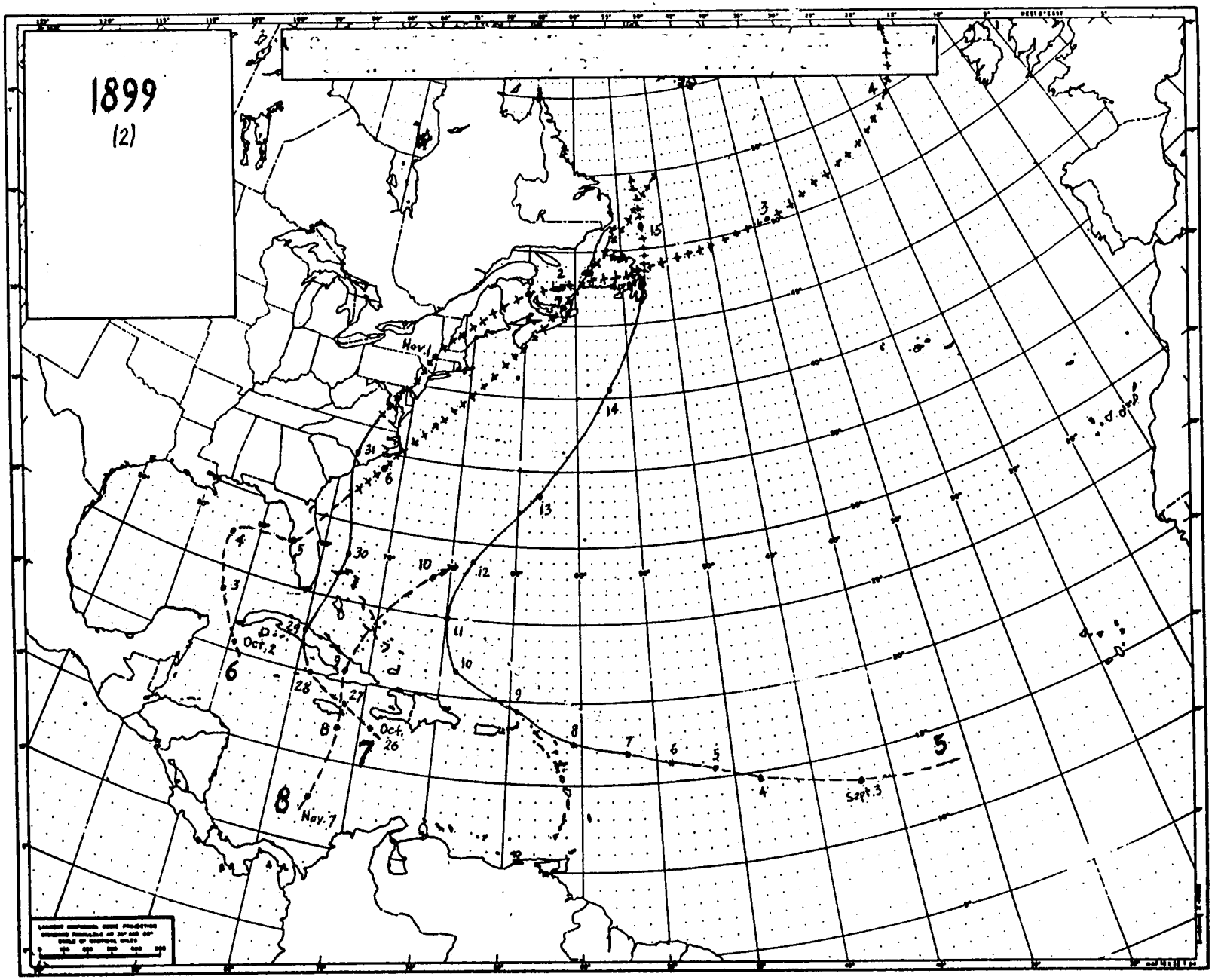

Fig. 2 (continued)

this storm (as for Storm 3, 1899) was found to be supported by the content of several of the items above, items 9) and 11) in particular. These two items were found to support hurricane intensity over the period Sept.3-4 and such intensity is indicated along the portion of the author's track which corresponds to both days. On the basis of a ship report which showed a wind of force 11, from the S. in the morning of Aug.31 (item 4), Storm 4, 1899 seems to have been approaching hurricane intensity in the eastern Caribbean Sea on that day; however, this could not be verified using information in other items and the author of this study decided to keep Storm 4, 1899 as a tropical storm while moving over the Caribbean Sea south of Hispaniola. The extratropical stage that Neumann et al. (1993) started on Sept,5 was accepted by the author of this study on the basis of information in item 10).

Storm 5, 1899 (Sept.3-15), H.

This is the same storm that Neumann et al. (1993) identify as Storm 4, 1899.

The following information was found about this storm: 1) The Barbados morning report of Sept.7 showed disturbed conditions to the northeastward of that station. A report from Barbados, timed 12:20 P.M., contained the following: Barometer irregular, unusual increase in height of sea on east coast (Monthly Weather Review, Sept.1899). 2) On Sept.7 the central office of the Weather Bureau at Washington adviced its observers in the eastern West Indies that conditions were threatening over the Lesser Antilles and to be alert to take local action if necessary. The morning of Sept.8 the approach of a severe storm from the eastward of St. Kitts was indicated and hurricane signals were ordered on that island, and advisory messages were telegraphed to all other observers in the threatened district. The center of the hurricane did not reach any of the islands of the West Indies and the winds of its west quadrant were severely felt only over the outlying Leeward Islands of the Lesser Antilles (Monthly Weather Review, Sept.1899). 3) The hurricane began (at St. Kitts) at 3:40 P.M. Sept.8 and ended at 2:25 A.M. Sept.9, lasting, therefore, ten hours and 45 minutes, during which time there was a total wind movement of 514 miles, or an average of 48 mph during the entire storm. The maximum velocity of the wind was 62 mph and occurred between 8:18 and 8:23 P.M. Sept.8. The extreme velocity was 120 mph at 5:51 P.M. The lowest reading of the barometer was 29.51 inches, occurring at 5 P.M., and the wind came from the S.W. during the entire storm. The total rainfall was 3.13 inches, the heaviest fall being during the first

two hours of the storm (Alexander, 1902). 4) About 5 A.M. Sept.8 the wind at St.Kitts, set in steadily from the N.W. and continued from that direction until 1 P.M., when it began shifting to the W. and increasing rapidly in force. From 1:45 to 3:40 P.M. the wind came from the W. with an average velocity of 36 mph. At 3:40 P.M. it shifted to the S.W. and soon reached verifying velocity. About 3:15 A.M. Sept.9, the wind began blowing from the S. and by noon it was coming steadily from that direction. Some barometer readings (at St.Kitts) were as follows: Sept.8, 7 A.M., 29.74 inches; 10 A.M., 29.68 inches; 1 P.M., 29.58 inches; 2 P.M., 29.54 inches; 3 P.M., 29.53 inches; 4 P.M., 29.52 inches; 5 P.M., 29.51 inches; 6 P.M., 29.52 inches; 7 P.M., 29.54 inches; 8 P.M., 29.62 inches; 9 P.M., 29.64 inches; 11:30 P.M., 29.69 inches; Sept.2, 2 A.M., 29.69 inches (Monthly Weather Review, Sept.1899). Author's note: According to the above publication, these data were provided by W.H. Alexander. U.S. Weather Bureau observer at St. Kitts. 5) During Thursday night (Sept.7) a tropical storm appeared E. of St. Kitts moving to the N.W. It developed hurricane proportions during Friday (Sept.8) and at 4 P.M. there was a terrific sea at St. Kitts with barometric pressure of 29.92 inches and a maximum wind of 48 mph from the S.W. (The New York Times, Sept.9, 1899, p.2, col.6). Author's note: The barometric pressure of 29.92 inches at St. Kitts is erroneous; according to information in item 4), the pressure there at 4 P.M. Sept.8 was 29.52 inches. 6) The tropical storm passed onto the ocean N. of Puerto Rico. San Juan reported a maximum velocity of 44 mph from the W. and St. Kitts the continuance of the terrific sea (The New York Times, Sept.10, 1899, p.2, col.5). Author's note: This statement was probably issued in the evening of Sept.9. 7) The hurricane which had been anticipated at St. Kitts reached that place and the wind yesterday attained a velocity of 56 mph from the S.W. At 5 P.M. it was still blowing at 54 mph from the S.W. indicating that the center was still N. of St. Kitts and that no trouble was likely in Puerto Rico (The New York Times, Sept.11, 1899, p.2, col.7). Author's note: The word "yesterday" was found to be misleading since it implies that the storm occurred at St. Kitts on Sept.10; actually the storm was felt there on Sept.8. 8) Maximum velocities were as follows: Basseterre (St. Kitts), S.W. 62 mph on Sept.8; Bridgetown (Barbados), S. 25 mph on Sept.8; San Juan, N.W. 31 mph on Sept.9 (Monthly Weather Review, Sept. 1899). Author's note: A wind velocity as high as 44 mph (from the W.) was reported to have occurred at San Juan on Sept.9 (item 6); that value is 13 mph higher than the one (31 mph) which is stated above. 9) A telegram received from the officer administering the Government of the Leeward Islands reports the occurrence on Sept.8 of a second hurricane which had caused further damage in Antigua and destroyed many houses in Barbuda and Anguilla (The Times, London, Sept.19, 1899, p.7, col.6). Author's note: In reference to the island on Anguilla, the Monthly Weather Review, Sept.1899, stated that as many as 200 houses were demolished and

that 800 people were rendered homeless. 10) Observations taken at 8 A.M. (E.S.T.) which were extracted from daily weather maps: Sept.8, Antigua, wind N. force 8; St. Kitts, wind N.W. force 4; Dominica, wind W. force 5, barometer 29.82 inches; ship near lat. 18.7 N., long. 63 W., wind N. force 5. Sept.9, San Juan, wind N.W. force 4, barometer 29.74 inches; St. Kitts, wind S. force 6, barometer 29.86 inches; ship near lat. 21 N., long. 67 W., wind N.E. force 6, barometer 29.88 inches; ship near lat. 23 N., long. 63.7 W., wind E. force 10, barometer 29.91 inches; storm center placed near lat. 19.5 N., long. 64 W. on the 8 A.M. (E.S.T.) Sept.9 weather map. Sept.10, Santo Domingo, wind S.W. force 4, barometer 29.86 inches; San Juan, wind S. force 3, barometer 29.86 inches; ship near lat. 20 N., long. 67 W., wind S.S.E. force 7, barometer 29.88 inches (obviously too high); ship near lat. 21.7 N., long. 64 W., wind S.E. force 7, barometer 29.97 inches; storm center placed near lat. 21.5 N., long. 69 W. on the 8 A.M. (E.S.T.) Sept.10 weather map. Sept.11, ship near lat. 27 N., long. 68 W., wind E. force 9; ship near lat. 27 N., long. 70 W., wind N.E. force 8; ship near lat. 23 N., long. 67.5 W., wind S.W. force 8; storm center placed near lat. 24 N., long. 69 W. on the 8 A.M. (E.S.T.) Sept.11 weather map. Sept.12, ship near lat. 29 N., long. 67.5 W., wind E.S.E. force 11; storm center placed near lat. 28.7 N., long. 68.3 W. on the 8 A.M. (E.S.T.) Sept.12 weather map (Historical Weather Maps, Sept. 1899). 11) Ship "Caracas" met the storm 400 miles N. of Puerto Rico, and experienced its fury from midnight Saturday (Sept.9-10) until Monday morning, Sept.11 (Monthly Weather Review, Sept. 1899). Author's note: The above information was sent to the U.S. Weather Bureau by W.H. Alexander, Observer, Basseterre, St. Kitts. 12) According to Capt. Heath, the "Newton", a 499 ton schooner which had sailed from Ship Island (in the Gulf of Mexico) for San Juan on Aug.15, was struck by a hurricane out of the E.N.E. at noon Sept.9 (Saturday) in lat. 22 50 N., long. 66 13 W. without little or no barometric warning. The wind blew with terrific violence as the night came on and at 11 P.M. the schooner dived into the sea. Tons of water were taken over the decks and the vessel strained and shook from stem to stern. The strain opened up many of seams forward through which the water was pouring in streams. Men worked at the pumps and labored during the night. At 6 A.M. Sunday morning (Sept.10) the vessel swung around in the way of a bucking beam sea which struck her on the starboard beam. The partially waterlogged vessel was hove down on her beam ends. All day Sunday the storm continued with unabated force. By Monday morning (Sept.11) the storm had abated somewhat but the sea was still running. The crew abandoned the schooner and was picked up by the "Fontabelle" during Wednesday night (Sept.13) and landed at St. Thomas on Sept.15 (The New York Times, Sept.25, 1899, p.1, col.5). Author's note: The Monthly Weather Review, Sept.1899 also stated that the "Isaac Newton" was waterlogged and dismasted on Sept.10, adding that the crew of the schooner, when rescued on Sept.13, were

in water waist deep and had been without food or fresh water for 3 days. In addition, the above mentioned publication stated that the crew reported the occurrence, during the hurricane, of a severe hailstorm, lasting about half an hour and producing intense cold. The hailstones were very large and fell with great force. 13) The steamship "Fontabelle" encountered the hurricane at midnight (Sept.11-12) in lat. 29 20 N., long. 68 20 W.. From 2 to 8:30 A.M. Sept.12, the wind blew at an estimated velocity of 90 mph, first from the E.S.E., then backing to E.N.E., after which, with diminished force, backed to S.W. Heavy rain from 1:30 to 4:30 A.M. Sept.12. The lowest pressure noted was 28.40 inches. The captain reports the loss of a large quantity of deck cargo and live stock, also that the storm was intensively severe and that the escape of the vessel from damage was remarkable (Monthly Weather Review, Sept.1899). Author's note: The above information was sent to the U.S. Weather Bureau by W.H. Alexander, Observer, Basseterre, St. Kitts. 14) Bermuda, Sept.13. A cyclone swept over the island last night, doing great damage to public and private property but no lives have been reported lost. The weather looked threatening early Tuesday morning (Sept.12) with a barometer falling. The storm began with rain at 2 P.M. after which there was a slight lull for a few hours with the wind S.S.E. and the barometer steadily falling. The wind suddenly backed to E. with cyclonic gusts. From 8 P.M. to midnight (Sept.12-13) it blew with hurricane force and was at its worst from 1 to 1:45 A.M. this morning. Then, after a short lull, the wind changed to S.W., when the principal damage was done, houses being blown down and others unroofed. Great cedars were uprooted, ornamental and fruit trees were destroyed and wharves were washed out into the sea (The New York Times, Sept.14, 1899, p.1, col.2). Author's note: An Associated Press dispatch, dated at Bermuda Sept.13, stated that, from what can be learned, there has been no loss of life. Such a dispatch was published in the Monthly Weather Review, Sept.1899. 15) New York, Sept.13. This information has been received here from Bermuda: A storm began at 2 P.M. yesterday (Sept.12) and continued the whole of the evening and night. Wharves were wrecked into the sea and considerable damage was also done to the military camp. Many small craft were sunk in the harbor or stranded (The Times, London, Sept.14, 1899, p.4, col.3). 16) Bermuda, Sept.14. A more detailed examination of the damage done by the hurricane shows that the breakwater of the naval yard has been severely damaged, the outer face being partially wrecked away and undermined. The damage to the Causeway previously reported was not overestimated. The Colonial Government property has suffered severely (The Times, London, Sept.15, 1899, p.4, col.1). 17) Extract of a hurricane description at Bermuda: The Weekly Report of the Weather by Walter S. Perinchief, Principal Keeper at Gibb's Hill Light Station gives: "Sept.13, 2 A.M., hurricane with barometer 27.73 inches". The hurricane seems to have reached its height between 11 and midnight (Sept.12-13) and

continued with unabated violence until a little past 2 A.M. (Sept.13). At 3 A.M. there was a lull for about half an hour during which the rain, that had fallen almost continuously for six hours, ceased and the wind shifted to N.W., rapidly growing its former strength. No abatement was noticed until about 8:30 A.M. (Sept.13), when the rain, which began again an hour or so previously, descended in white hissing sheets and lasted until 9 o'clock. Damage estimated to run into at least five figures was sustained at Her Majesty's Dockyard, Ireland Island; while Prospect Camp was described as looking "something as Alexandria after the bombardment". Many large buildings on the South Shore which withstood the hurricane of 1839, have been driven for some distance inland. The fall of the barometer was something marvelous; it seemed to go down with bounds, and when at 2:30 A.M. (Sept.13) it reached 27.99 inches one was prepared for anything from a double-barrelled cyclone to the Last Day. In speaking of this particular hurricane, A.E. Verill laments that "there is scarcely anything recorded of the changes that it wrought on the exposed cliffs, though such effects were sufficiently obvious a year later all along the southern shores". In a letter to her father, who was at Montreal at the time, Miss. Lilliam Hare Hayward wrote on Sept.15 in reference to the barometer: "I have every reason to believe that ours registered 27.45 (inches) in the middle of the hurricane at 2 A.M. (Sept.13), there was a most ominous lull then, the barometer was at its lowest and I am told that the sky at midnight was crimson. Ours, of course, is a high glass; Mr. Henry Smith and Mr. Ed. Gosling state their reading was 27.06 (inches)" (Tucker, 1982). Author's note: The most reliable of the four barometer readings given above appears to have been the one of 27.73 inches taken at Gibb's Light Station. 18) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Sept. 13, ship near lat. 35 N., long. 62 W., wind N.N.E. force 6; ship near lat. 35 N., long 58 W., wind S. force 6; storm center placed near lat 34.5 N., long.61 W.on the 8 A.M. (E.S.T.) Sept.13 weather map. Sept.14, storm center placed near lat. 41 N., long. 56.5 W. on the 8 A.M. (E.S.T.) weather map. Sept.15, storm became extratropical; big low placed N. of Newfoundland (Historical Weather Maps, Sept.1899). 19) The "Lucania" arrived off Fire Island at 9:45 P.M. Saturday evening. On Thursday last (Sept.14) the "Lucania" encountered what Capt. Mc Kay and officers agree was the most violent hurricane ever met by them in the Atlantic Ocean. At noon a fresh breeze suddenly sprang up from the S.W. veering to S.S.W. and the barometer took a startling slump. The wind continued to strengthening until 3 P.M. when it assumed hurricane force, ripping up a tremendous sea. The water deluged the decks and swept 60 chairs from the promenade deck. The vessel was promptly hove to. The hurricane lasted until 6 P.M., subsiding into a heavy gale, which, however, moderated by midnight (The New York Times, Sept.18, 1899, p.3, col.1). 20) St. John's, Newfoundland, Sept.15. A violent hurricane swept this section of

Newfoundland last night. The "Corean", from Philadelphia, had a frightful passage and the "Silvia", from New York, was delayed 24 hours. Widespread destruction of fishing premises and gear is reported and it is feared that there has been much damage and probably loss of life at more distant points (The New York Times, Sept.16, 1899, p.1, col.6). 21) St. John's, Newfoundland, Sept.16. Extensive damage was done along the coast by the Thursday night (Sept.14) storm. Seven more fishermen were reported to have been drowned. Scores of schooners and other craft were demolished. The steamer "Regulus" had her coal and cargo shifted and almost sank. The steamer "Alaska", from New York to Tilt Cove, had her decks swept and her main steam pipe broken (The New York Times, Sept.17, 1899, p.1, col.6). Author's note: The number of deaths mentioned in this item was found to be larger than the 4 deaths that the Monthly Weather Review, Sept.1899 attributed to the storm in Newfoundland. 22) Storm of Sept.3-21, 1899. Atlantic (Tannehill, 1938). 23) Map showing a track for the storm along which the following morning positions were displayed: Sept.8, near lat. 18 N., long. 61.3 W.; Sept.9, near lat. 20.7 N., long. 64.3 W.; Sept.10, near lat. 23 N., long. 66.3 W.; Sept.11, near lat. 26.5 N., long. 67.3 W.; Sept.12, near lat. 29 N., long. 66.3 W.; Sept.13, near lat. 33.3 N., long. 63.7 W. (Monthly Weather Review, Sept.1899). 24) A Sept. 1899 storm appeared near lat. 17 N., long. 61 W., recurved near lat. 25 N., long. 67 W. and disappeared over midocean (Garriott, 1900). Author's note: A track for the storm is included in Garriott (1900); such a track was found to be very similar to the one shown in the Monthly Weather Review, Sept. 1899 (item 23). 25) A storm was first observed near lat. 13 N., long. 43 W. on Sept.3, 1899 and lasted 18 days; it recurved near lat. 26 N., long. 70 W. and it was last observed near lat. 60 N., long 10 E. (Mitchell, 1924). Author's note: A track which is also included in Mitchell (1924) was found to be quite similar to the one in Neumann et al. (1993) as for Storm 4, 1899.

Information in above items suggested the need for some modifications along the track of this storm which is displayed in Neumann et al. (1993). Due to the lack of suitable information in those items, their track before Sept.7 could not be checked and, therefore, the author decided to accept it. Their 7 A.M. Sept.7 position was found to be reasonable in accordance to information in item 1) and, consequently it was also accepted. On the basis of meteorological observations taken in the morning of Sept.8 (items 4 and 10) and information in item 9) which suggested that the center of the hurricane passed quite close to the N. of Barbuda and Anguilla, the 7 A.M. Sept.8 position in Neumann et al. (1899) was adjusted to the S. by about 30 miles to near 17.5 degrees N., 60.5 degrees W. Their 7 A.M. Sept.9 position was also slightly adjusted to the S.to near 19.5 degrees N., 64.5 degrees W. in order to fit better the information contained in items 4) and 10) through 12).

The author's 7 A.M. Sept.10 position was estimated near 21.7 degrees N., 68.7 degrees W., primarily on the basis of morning observations for that day (item 10) but also using information in items 11) and 12); this position was found to be about 100 miles to the S. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Sept.11 position was estimated near 25.0 degrees N., 70.0 degrees W. on the basis of morning observations for that day contained in item 10); this position was found to be about 120 miles to the S. of the one in the above mentioned publication. The author's 7 A.M. Sept.12 position was estimated near 28.7 degrees N., 68.3 degrees W. on the basis of information for that day in item 10) and the observations provided by the "Fontabelle" (item 13); this position was found to be about 100 miles to the S.W. on the one in Neumann et al. (1993). The 7 A.M. Sept.13 position in the latter publication was kept unchanged because it was found to agree very well with the passage of the eye of the storm over Bermuda about 5 hours earlier (items 14 and 17) and, in addition, the morning location given for that day in item 18) was found to be too far to the N.E. to support the time of such passage. The 7 A.M. Sept.14 position in Neumann et al. (1993) was slightly adjusted to the N.E. to near 40.5 degrees N., 57.0 degrees W. in order to fit better the information for that day in item 18) and to obtain a better space-time continuity along the storm track. Finally, the author of this study estimated a 7 A.M. Sept.15 position near 51.5 degrees N., 52.5 degrees W. on the basis of information in items 18), 20) and 21); this position was found to be about 300 miles to the N. of the corresponding one in Neumann et al. (1993). The author's track for Storm 5, 1899 is displayed in Fig.2.

The hurricane status that Neumann et al. (1993) gave to this storm as for Storm 4, 1899 was found to be supported by the content of many of the 25 items above. As for the track in Neumann et al. (1993), the author's track denotes hurricane intensity starting on Sept.6 and tropical storm status prior to that day. Transformation into an extratropical system was denoted along the author's track at about lat. 48 N., when the storm was leaving Newfoundland after having affected that island in the night of Sept.14 (items 20 and 21). The author believes that his decision of having kept the storm as a hurricane until it left Newfoundland was fully justified by the fact that the "Lucania" encountered very violent hurricane conditions in the evening of Sept.14 (item 19).

Storm 6, 1899 (Oct.2-7), T. S.

This storm corresponds to Storm 5, 1899 in Neumann et al.

(1993).

The following information was found about this storm: 1) There is evidence of a disturbance over the western part of the Caribbean Sea but its strength and future course cannot as yet be determined. Heavy rain is reported from the Florida peninsula, a rainfall of 4.94 inches being noted at Jupiter (The New York Times, Oct.3, 1899, p.3, col.6). Author's note: The location given in this weather statement, as well as in similar ones published in The New York Times, probably corresponds to the evening before their publication date. 2) A general disturbance which has been moving W. over the western portion of the Caribbean Sea during the past 2 days has passed out into the Gulf of Mexico. During yesterday the wind gradually increased along the Middle Gulf coast and on the East Florida coast, with a maximum velocity of 40 mph at Port Ead and 37 mph at Jupiter, which also reported rough seas and the highest tide in 7 years (The New York Times, Oct.4, 1899, p.3, col.6). 3) The Gulf of Mexico disturbance was apparently approaching the West Florida coast yesterday. Maximum velocities of 48 mph from the N.E. and 36 mph from the S.E. were reported from Port Eads and Jupiter, respectively. Although the storm strength at the center had not been determined, storm signals were ordered yesterday morning from New Orleans to Charleston (The New York Times, Oct.5, 1899, p.2, col.7). 4) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Oct.1, ship near lat. 15 N., long. 81 W., wind N. force 2; ship near lat. 20.7 N., long.80 W., wind E. force 4; ship near the W. coast of Isle of Pines, wind N.E. force 4. Oct.2, Cienfuegos, wind N.E. force 2, barometer 29.87 inches; Havana, wind E. force 2, barometer 29.90 inches; Key West, wind N.E. force 4, barometer 29.93 inches; ship near lat. 22.8 N., long. 84.8 W., wind E.N.E. force 5; ship near lat. 25.7 N., long. 85.5 W., wind E. force 6, barometer 29.97 inches; ship near lat. 26 N., long. 83.7 W., wind E. force 6; ship near lat. 17.2 N., long 84.8 W., no wind, no pressure. Oct.3, Port Eads, wind E.N.E. force 6; Pensacola, wind N.E. force 3, barometer 30.10 inches; New Orleans, wind N.E. force 4, barometer 30.09 inches; Tampa, wind N.E. force 3, barometer 29.98 inches; ship near lat. 26.2 N., long. 87.2 W., wind E.N.E. force 10, barometer 29.80 inches; ship near lat. 28 N., long. 86 W., wind N.E. force 9; Merida, wind N.W. force 2, barometer 29.83 inches; ship near lat. 21 N., long. 86 W., wind W. force 2, barometer 30.24 inches (obviously too high); ship near lat. 21 N., long. 83 W., wind S.W. force 2, barometer 29.91 inches; storm center placed near lat. 25 N., long. 86.5 W. on the 8 A.M. (E.S.T.) Oct.3 weather map. Oct.4, Merida, wind W. force 2, barometer 29.88 inches; Havana, wind S.S.E. force 3, barometer 29.85 inches; Key West, wind S.E. force 3, barometer 29.89 inches; New Orleans, wind N.E. force 4; ship off Cape San Antonio, wind S.W. force 4, barometer 29.83 inches; ship near lat. 27.8 N., long. 86 W., wind S.S.E. force 4, barometer

29.83 inches; ship near lat. 29 N., long. 87 W., wind E.N.E. force 10; storm center placed near lat. 25.5 N., long. 88.5 W. on the 8 A.M. (E.S.T.) Oct.4 weather map (the center might have actually been some distance to the N.E. of the position shown on the map). Oct.5, Tampa, wind N.E. force 1, barometer 29.77 inches; Jacksonville, wind E. force 2, barometer 29.81 inches; Key West, wind S.W. force 3, barometer 29.86 inches; Pensacola, wind N.E. force 3, rain, barometer 29.92 inches; ship near lat. 28.7 N., long. 80 W., wind S. force 2; ship near lat. 25.7 N., long. 85 W., wind W. force 3; ship near lat. 26.7 N., long. 87 W., wind W.N.W. force 5; storm center placed just N. of Tampa on the 8 A.M. (E.S.T.) Oct.5 weather map, but wind N.E. force 1 at that station, with the lowest barometer of 29.77 inches, suggested the center to have been practically over there at map time (Historical Weather Maps, Oct.1899). 5) The Gulf storm has moved N.E. over the Florida peninsula and was central last evening near Jacksonville. Storm signals are displayed from Port Eads to Norfolk, except at Key West (The New York Times, Oct.6, 1899, p.3, col.4). 6) The Gulf storm has moved rapidly to the N.E. and is now central off the S.E. New England coast. Rain has fallen on the Atlantic coast from Florida northward, a maximum velocity of 56 mph being reported from Cape Henry and Block Island (The New York Times, Oct.7, 1899, p.2, col.5). 7) At Havana (Belen College Observatory) the lowest pressure related to the cyclone of Oct.2-6, 1899 was 755.7 millimeters (29.75 inches) and occurred on Oct.6 (Sarasola, 1928). 8) Maximum wind velocities of 37 mph from the N. and 47 mph from the N. were recorded at Boston and Woods Hole, respectively, on Oct.6 (Monthly Weather Review, Oct.1899). 9) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Oct.6, Hatteras, wind S.E. force 2, barometer 29.62 inches; Wilmington, wind N. force 2, barometer 29.65 inches; Charleston, wind N.W. force 3, barometer 29.68 inches; Jacksonville, wind W.N.W. force 2, barometer 29.71 inches; Tampa, wind S.W. force 2, barometer 29.73 inches; ship near lat. 32.5 N., long. 75.5 W., wind S.S.W. force 9, barometer 29.53 inches (it might be in error because of difficulties in reading the value off the map); ship near lat. 33 N., long. 75 W., wind S.S.W. force 5, barometer 29.62 inches; frontal low off Carolina coast, with cold front passing between Jacksonville and Tampa. Oct.7, winds in the Nova Scotia area suggested center of low near lat. 47 N., long. 60.5 W. (Historical Weather Maps, Oct.1899). 10) Storm of Oct.2-9, 1899. Gulf, Florida, Atlantic. Of small force (Tannehill, 1938). 11) Map showing a track for this storm. The following positions were read off the map: Oct.3 (morning), near lat. 21.5 N., long. 81.3 W.; Oct.3 (evening). near lat. 23.5 N., long. 83 W.; Oct.4 (morning), near lat. 26 N., long. 84 W.; Oct.4 (evening), near lat. 27 N.. long. 83.7 W.; Oct.5 (morning), near lat. 28 N., long. 82.7 W.; Oct.5 (evening), near lat. 30.3 N., long. 80.3 W.; Oct.6 (morning), near lat. 35.7 N., long. 74.5 W.; Oct.6 (evening), near lat. 41 N., long. 68.7 W.;

Oct.7 (morning), near lat. 46.5 N., long, 59.5 W. (Monthly Weather Review., Oct.1899). 12) An Oct.1899 storm appeared near lat. 21 N., long. 82 W., recurved near lat. 26 N., long. 84 W. and disappeared near Newfoundland (Garriott, 1900). 13) A storm was first observed near lat. 20 N., long. 85 W. on Oct.2, 1899 and lasted 7 days; it recurved near lat. 26 N., long. 86 W. and it was last observed near lat. 52 N., long. 54 W. (Mitchell, 1924). Author's note: A track which is also shown in Mitchell (1924) was found to be quite similar to the one displayed in Neumann et al. (1993) as for Storm 5, 1899.

Information in the above items allowed the author of this study to introduce some modifications along the track for this storm which is displayed in Neumann et al. (1993). Their 7 A.M. Oct.2 position was kept unchanged because it was found to be reasonable in the light of information for that day in item 4). Information for Oct.1 in that item suggested the possibility that the storm circulation might have already existed well to the S. of central Cuba on that day, but no attempt was made to extend the track backward in time because the light northerly wind reported by a ship in the western Caribbean Sea was insufficient for documenting the existence of a closed circulation at the surface. The following 7 A.M. positions for the period Oct.3-5 were estimated by the author of this study on the basis of morning observations in item 4): Oct.3, near 23.7 N. degrees N., 86.5 degrees W.; Oct.4, near 27.3 degrees N., 87.0 degrees W.; Oct.5, near 28.0 degrees N., 82.5 degrees W. The three positions above were found to be about 40 miles to the N.N.W., about 90 miles to the N.W. and about 60 miles to the S.S.E. of the corresponding ones in Neumann et al. (1993). The following 7 A.M. positions for the period Oct.6-7 were estimated on the basis of information contained in item 9): Oct.6, near 34.0 degrees N., 76.5 degrees W.; Oct.7, near 46.3 degrees N., 61.3 degrees W. These positions were found to be about 140 miles to the S.W. and about 270 miles to the N.E. of the respective ones in Neumann et al. (1993). The author decided to terminate the track on Oct.7 on the basis that the storm was said to have been last observed near lat. 52 N., long. 54 W. (item 13), which is also near Newfoundland as indicated in item 12). The author's track for Storm 6, 1899 is shown in Fig.2.

The tropical storm status that Neumann et al. (1993) gave to this storm as for Storm 5, 1899 was supported by information contained in several of the above items. However, extratropical characteristics were observed as the storm moved towards Cape Hatteras on the morning of Oct.6 (item 9). Therefore, the author of this study decided to start denoting such characteristics on his track when the storm reached the 32 degrees N. parallel early that day.

Storm 7, 1899 (Oct.26-Nov.4), H.

This is the same storm that Neumann et al. (1993) identify as Storm 6, 1899.

The following information was found in relation to this storm: 1) Belen College Observatory, Oct.26, 6 P.M. There are some indications of an ill-defined cyclonic perturbation in the Caribbean Sea to the S.E. of this island. At Santiago de Cuba the barometer read 29.85 inches at 7:30 A.M. (Oct.26), light rain fell continuously all night; at 11 A.M. , barometer 29.84 inches, calm, cloudy, low clouds coming from the E.; at 3 P.M., barometer 29.79 inches, intermittent light rain. Heavy rain fell all morning at Holland Bay (Jamaica), where rough sea was observed. At Kingston, noon, barometer 29.80 inches, light wind from S., rain. L. Gangoiti, S.J. (Diario de la Marina, Havana, Oct.27, 1899, p.1, col.8). Author's note: L. (Lorenzo) Gangoiti, S.J. was the director of the Belen College Observatory at Havana. 2) According to information obtained from the Weather Bureau office (here), the low pressure area remains S. of Santiago de Cuba where the barometer today is somewhat lower than yesterday, but this does not mean that there are indications of a storm (Diario de la Marina, Havana, Oct.27, 1899, evening edition, p.2, col.1). 3) Belen College Observatory, Oct.27, 7 P.M. The cyclonic perturbation is better organized than yesterday; its center appears to be between Jamaica and Cuba. At Santiago de Cuba, barometer 29.80 inches, heavy and continuous rain all night, wind N.N.E., low clouds coming from the E.S.E. Holland Bay, calm sea, heavy and continuous rain, S.W. At Jamaica (probably Kingston), noon, barometer 29.75 inches, light and continuous rain, wind W. 10 mph. Tunas de Zaza, barometer 29.83 inches, wind N.E., variable and strong, high clouds coming slowly from the S., low clouds being ragged by the wind, drizzle, cumulus and nimbus clouds all over the horizon. L. Gangoiti, S.J. (Diario de la Marina, Havana, Oct.28, 1899, morning edition, p.5, col.8). 4) The most important storm of Oct.1899 advanced from the W. part of the Caribbean Sea along the east coast of the United States from Oct.28 to Oct.31. For several days preceding Oct.28 unsettled weather had prevailed over the Greater Antilles and the western Caribbean Sea and a marked barometric gradient between that region and an area of high barometer over the S.E. United States caused high N.E. winds over S. Florida, Cuba and adjacent waters, and careful watch was kept for a storm development which, at this season, these conditions favored. The evening reports of Oct.27 showed the looked-for storm development south of central Cuba and storm signals were ordered at Key West and Miami, with the

information that the center of the disturbance would probably move N,W. during the next 24 hours and cause high N.E. winds over southern Florida and western Cuba (Monthly Weather Review, Oct.1899). Author's note: Similar information was published in The New York Times, Oct.27, 1899, p.2, col.6 and in The New York Times, Oct.28, 1899, p.3, col.7. 5) Belen College Observatory, Oct. 28, 11 A.M. The cyclonic perturbation is moving W., with a tendency to recurve. At 8 A.M. today the center was located to the S.E. of Havana, between Tunas de Zaza and Cape Cruz, as inferred from the cloud bank of the hurricane which we are observing this morning (from Havana) and from the following observations: Santiago de Cuba, barometer 29.83 inches, intermittent heavy showers, wind S.E. Holland Bay (Jamaica), gusty wind from S.W., good sea condition. Cienfuegos, barometer 29.76 inches, cloudy, wind E.N.E., low clouds coming from E.N.E., cirrus arc to the S.E. Tunas de Zaza, barometer 29.76 inches, wind N.E. to E.N.E., strong gusts, cirrus shield, swell from S.E. and S. Cardenas, strong breeze, intermittent light rain, low cumulus clouds coming from E.N.E., high cumulus coming from E., cirrus arc to the S.E. L. Gangoiti, S.J. (Diario de la Marina, Havana, Oct.28, 1899, evening edition, p.2, col.1). 6) Belen College Observatory, Oct.28, 7 P.M. The motion of the cyclonic perturbation is slow this evening, with increased intensity. It continues in the area limited by Tunas de Zaza, Cape Cruz and Grand Cayman. L. Gangoiti, S.J. (Diario de la Marina, Havana, Oct.29, 1899, morning edition, p.2, col.5). 7) Belen College Observatory, Oct.29, 5 P.M. There is no danger to Havana province because the tempest has moved over Santa Clara province, passing some distance E. of Cienfuegos and turning to the N. At this time the main center is entering the Atlantic. Some of the telegrams which were sent to us by our observers are as follows: Santiago de Cuba, barometer 29.71 inches, strong S.E. wind with heavy gusts. Tunas de Zaza (evening of Oct.28), barometer 29.58 inches, moderate tempest from N.E., cloudy, rough sea from S. Cienfuegos, barometer 29.45 inches, wind N.W., heavy and continuous rain. Cardenas, barometer 29.56 inches, strong N.N.W. wind, tempest threatening, intermittent heavy showers. The direction low clouds were coming from at Havana was N.N.E. at 6 A.M. (Oct.29), N. one-quarter E. at 8 A.M. and N.W. at noon. L. Gangoiti, S.J. (Diario de la Marina, Oct.30, 1899, evening edition, p.1, col.6 and p.2, col.1). 8) Additional observations: Tunas de Zaza (Mr. Periu, observer), Oct.28, 8 P.M., barometer 29.53 inches, sometimes calm, others wind from N. and S.E., more or less strong; 10 P.M., barometer 29.50 inches, falling rapidly (this statement seems to be in error), distant lightning to S.S.W. and S.W., rough sea; midnight (Oct.28-29), barometer 29.40 inches, gusty winds from E. and E.S.E., heavy swell from S.W., very low clouds; Oct.29, 2 A.M., barometer 29.40 inches, some clearing observed to the S.; 4 A.M., barometer 29.41 inches, heavy showers returned from S.E. and S., heavy sea; 6 A.M., barometer 29.42 inches, heavy showers from the

S.W., same sea condition, small clearing to the S.W. Steamship "Cosme de Herrera", (Capt. Manuel Ginesta), at Caibarien, Oct.29, 4 A.M., barometer 29.72 inches, very strong wind, visibility very reduced by heavy rain; daybreak, wind blowing at cyclone intensity, terrible squalls, barometer 29.69 inches; after sunrise, wind appeared to be less intense out of the E.S.E. and S.E.; 8 A.M., clearing to the S., wind suddenly became calm, barometer 29.68 inches; calm conditions and very dark horizons to the S.W. and N.W. prevailed until 11:30 A.M., when strong winds started blowing from the S.W.; noon, barometer 29.67 inches. According to reports from the captain of the "Humberto Rodriguez" and several others, calm began at Sagua at 7:30 A.M. Capt. Deschamps of the steamer "Alfonso XIII" reported to have encountered strong winds from the second and third quadrants as the storm moved towards the Carolina during the afternoon of Oct.30 (Diario de la Marina, Havana, Nov.18, 1899, evening edition, p.2, cols.1 and 2). Author's note: The above information was extracted from a note signed by L. Gangoiti of the Belen College Observatory. Sagua and Caibarien are located on the northern coast of central Cuba. 9) During yesterday (Oct.29) a center of a disturbance moved N. over central Cuba and at 8 P.M. occupied a position about 150 miles E. of Key West. The lowest barometer noted in connection with the storm was 29.40 inches at 8 A.M. yesterday. It is calculated that the storm will move N.E. off the South Atlantic coast, attended today by N.E. gales from Virginia southward (The New York Times, Oct.30, 1899, p.2, col.7). 10) Sagua la Grande, Oct.29. Since yesterday (Oct.28) we are under the influence of a cyclone. Last night we had rain with intermittent strong gusts from the E. The barometer drop has been considerable from 2 A.M. (Oct.29) and now, 8 A.M., the corrected aneroid registers 752 millimeters (29.61 inches). The wind has already done some damage to banana plantations, The rain gauge recorded a rainfall of 4 inches during last night. The (Sagua) river has begun to overflow and has now reached 1.5 meters about its bed but, to the present, the flood is not alarming (Diario de la Marina, Havana, Oct.30,1899, p.2, col.3). 11) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Oct.26, Camaguey, wind E. force 3, barometer 29.84 inches; Santiago de Cuba, wind E. force 2, barometer 29.80 inches; Kingston, wind N.E. force 2, barometer 29.77 inches (not clearly read off the map); Port-au-Prince, wind E. force 5, barometer 29.76 inches; Cienfuegos, wind N. force 2, barometer 29.86 inches; Havana, wind N.E. force 5, barometer 29.91 inches; ship near lat. 21 N., long. 80 W., wind E. force 10, barometer 29.97 inches (too high); ship off Cape Cruz, wind E. force 6, barometer 29.77 inches (maybe too low); ship near lat. 21 N., long. 73.7 W, wind E.N.E. force 8, barometer 29.91 inches (not clearly read off the map. Oct. 27, Santiago de Cuba, wind N.E. force 3, barometer 29.74 inches; Camaguey, wind E.N.E. force 4, barometer 29.76 inches; Cienfuegos, wind N.E. force 4, barometer 29.78 inches; Havana, wind N.E. force

5, barometer 29.86 inches; Kingston, wind S.E, force 3, barometer 29.76 inches; Port-au-Prince, wind E. force 6, barometer 29.76 inches. Oct.28, Kingston, wind S.E. force 5, barometer 29.75 inches; Santiago de Cuba, wind S.E. force 4, barometer 29.77 inches; Camaguey, wind E. force 5, barometer 29.72 inches; Cienfuegos, wind N.E. force 3, barometer 29.71 inches; Havana, wind N.E. force 3, barometer 29.83 inches; ship near lat. 20.3 N., long. 83 W., wind N.E. force 6, barometer 29.68 inches (probably too low). Oct.29, Jupiter, wind E. force 4, barometer 29.78 inches; Key West, wind N.E. force 5, barometer 29.71 inches (not clearly read off the map); ship near lat. 27.5 N., long. 77.5 W., wind E.N.E. force 6, barometer 29.86 inches; ship near lat. 26 N., long. 76 W., wind E. force 9, barometer 29.50 inches (obviously too low); ship near lat. 25 N., long. 74 W., wind E.S.E. force 8, barometer 29.77 inches; ship near lat. 22.3 N., long. 74 W., wind E.S.E. force 6, barometer 29.68 inches; Santiago de Cuba, wind S.E. force 4, barometer 29.71 inches; Camaguey, wind S.E. force 4 (wind direction and speed not clearly read off the map), barometer 29.59 inches; Cienfuegos, wind W. force 4, barometer 29.38 inches; Havana, wind N. force 5, barometer 29.68 inches; ship near lat. 20 N., long. 84 W., wind N. force 10 (probably too high), barometer 29.83 inches; ship near lat. 18 N., long. 78 W., wind S.W. force 6, barometer 29.59 inches (too low); ship near lat. 17 N., long. 79 W., wind W.S.W. force 5; Kingston, wind S.E. force 5, barometer 29.75 inches (Historical Weather Maps, Oct.1899). 12) The minimum pressure which was recorded at Havana (Belen College Observatory) in association with this cyclone was 751.2 millimeters (29.58 inches) and occurred on Oct.29 (Sarasola, 1928). 13) Oct.28-29, 1899. A cyclone of good intensity which formed between Jamaica and Santiago de Cuba moved to the N.W., reaching the southern coast of Cuba between Tunas de Zaza and Cienfuegos while turning to the N.N.W. towards the Florida Straits. It caused great flooding and damage to the country as well as the blowing down of some houses and loss of life (Sarasola, 1928). Author's note: Actually taken from the catalog of Cuban cyclones by M. Gutierrez-Lanza which is included in Sarasola (1928). 14) Extracts from newspapers published at Santa Clara province: Remedios. From 5 P.M. Oct.28, the rain storm became more intense. A strong wind began blowing at 10:30 P.M., lasting until the early morning of Oct.29. Camajuani. The lower part of the town was flooded during the night of Oct.28, but no casualties occurred. Sancti-Spiritus. A train had left town for Tunas de Zaza in the night of Oct.28 to assist the inhabitants of the latter place. The train returned to Sanct-Spiritus in the morning of Oct.29 bringing a number of families that were fearing a flooding as the Zaza River threatened to overflow. Strong gusts blew several houses at Sancti-Spiritus but no loss of life was reported (Diario de la Marina, Havana, Nov.1, 1899, p.2, col.1). Author's note: The Monthly Weather Review, Oct.1899 also published a brief account of storm damages in Cuba which was sent Mr. W.B.

Stockman, Forecast Official of the Weather Bureau office at Havana. 15) Santiago de Cuba, Oct.29. After 5 days of continuous rain storms, a terrific hurricane from S.E. swept, causing considerable destruction. Twelve houses were wrecked and others badly damaged. Telegraph lines are down and it is impossible for vessels to enter or leave the harbor (The New York Times, Oct.30, 1899, p.7, col.2). Author's note: The use of the word hurricane in the above dispatch is misleading. Indeed, the storm was over central Cuba and not near Santiago de Cuba on Oct.29. The word "hurricane" seems to refer in this case to strong winds affecting the above mentioned city. 16) Kingston, Jamaica, Oct.29. Reports on the severe rain storm that have swept the country arrive from various points and confirm the fear that extensive damage has been done. The Rio Cobre inundated Spanish Town, doing considerable harm. Advices from the town of Black River report great damage to shipping and wharves there, as well as serious damage to crops (The New York Times, Oct.30, 1899, p.7, col.2). 17) Norfolk, Va., Nov.11. The schooner "Henry P. Mason", from Galveston to Philadelphia, put into Hampton Roads today. The "Mason" got as far as the Florida coast where a hurricane which lasted 3 days struck her on Oct.29 (The New York Times, Nov.12, 1899, p.3, col.2). 18) During Oct.30 the center of the disturbance moved northwards and in the evening was central off the Carolina coast. On the morning of Oct.30 the display of storm signals was extended to Sandy Hook, N.J. and advisory messages regarding the character and course of the storm were sent northward to Boston. The morning reports showed a marked increase in the intensity of the storm and coast interest along the middle Atlantic and south New England coasts were notified that dangerous N.E. gales might be expected. During the northward passage of the storm severe gales were encountered along the south and middle Atlantic and south New England coasts (Monthly Weather Review, Oct.1899). 19) Observations taken at 8 A.M. (E.S.T.) which were taken from weather maps: Oct.30, ship near lat. 29 N., long. 75 W., wind E.S.E. force 12, barometer 29.26 inches; ship near lat. 27 N., long. 73 W., wind S.E. force 9, barometer 29.59 inches; ship near lat. 26 N., long. 74 W., wind S. force 6; Jupiter, wind N.W. force 4, barometer 29.52 inches; Key West, wind N.W. force 5, barometer 29.70 inches; storm center shown near lat. 27.7 N., long. 76.7 W. on the 8 A.M. (E.S.T.) Oct.30, 1899 map. Oct.31, data difficult to read off the map in the vicinity of the storm center. Center with pressure below 985 millibars (29.09 inches) shown on the 8 A.M. Oct.31. 1899 map to have been located to the S. of Wilmington; however, as read off the map, the wind there seems to have been from the S. (no force could be read), suggesting that the center was then to the N.W. of the station (Historical Weather Maps, Oct.1899). 20) At Charleston, S.C. the wind reached a velocity of 58 mph from the N.W, at 10:05 P.M. Oct.30. The News and Courier (Charleston, S.C., Oct.31, 1899) published an interview with Mr. L.N. Jesunofsky of the Weather Bureau in which he announced the

occurrence of that wind and added that "the wind has increased a little since that time". A dispatch from Florence, dated on Oct.31, indicated that between 11 P.M. Oct.30 and 2 A.M. Oct.31 the wind seems to have reached its height (there) which was very nearly 70 mph, while the rain seemed to have come down in sheets. Many buildings were either unroofed or moved from their foundation, a large amount of fencing blown down and the trees badly twisted and broken (as published in The News and Courier, Charleston, S.C., Nov.1, 1899). The Morning Start, Wilmington, N.C., Nov.1, 1899 published the following account given by Capt. F.C. Miller of the steamer "Catherine Whiting", which was wrecked at Goss Beach, Brunswick County (N.C.) during the hurricane: "About 12 o'clock Tuesday (midnight Oct.30-31) there was a dead calm for 15 minutes and then the wind shifted to the east...The wind then shifted to S.E. and caused the ocean to sweep right in towards shore...The ship began to drift rapidly towards the land which was 2 or 3 miles away. At 4 A.M. Tuesday the ship got in the breakers and struck bottom, with a heavy thump, in 4 fathoms of water..." From the record of the storm written in the Wilmington Weather Bureau station journal: The wind gradually increased in force from the S.E., reaching a gale velocity at 3 P.M. (Oct.30) and became very severe during evening. The gale continued very severe during the night and forenoon (Oct.31) accompanied by heavy rain till 4:50 A.M. and light showers from 8:10 A.M. to 3:30 P.M. Rapid and decided fall of barometer until 5 A.M. (Oct.31) when it reached 28.90 inches (actual). After this time it began to rise rapidly. The wind gradually veered from N.E. to S.E. during the night, blowing with increased force, reaching a maximum velocity of 43 mph from the S.E. at 4:50 A.M. The wind came in great gusts at times, reached extreme velocities of 50 to 55 mph. Towards noon the wind began to shift to S.W., becoming steady from that direction at 4 P.M. and gradually decreasing in force. Gale ended at 8:07 P.M. At the summer resort beaches -Wrightsville Beach 10 miles due E. and Carolina Beach 18 miles S.E.- the wind and tide played havoc. The amount of damage done in Wilmington and vicinity is enormous, not so much by the high winds but my the tremendously high tide accompanying. The tide reached nearly the highest point in the history of the port, and much damage was due to submerged wharves and warehouse floors (Ho, 1989). Author's note: The Monthly Weather Review, Oct.1899 also refers to the maximum velocities at Charleston and Wilmington and to the wreck of the "Catherine Whiting". 21) Some observations taken at Charleston, S.C.: Oct.30, 6 P.M. (E.S.T.), barometer 29.48 inches, wind N. 29 mph; 8 P.M., barometer 29.38 inches, wind N.N.W. 31 mph; 10 P.M., barometer 29.18 inches, wind N.N.W. 44 mph; midnight (Oct.30-31), barometer 29.10 inches, wind N.W. 36 mph; Oct.31, 2 A.M., barometer 29.08 inches, wind N.W. 30 mph; 4 A.M., barometer 29.08 inches, wind N.W. 23 mph; 6 A.M., barometer 29.13 inches, wind W.N.W. 21 mph; 8 A.M., barometer 29.25 inches, wind W. 21 mph; 10 A.M., barometer 29.31

inches, wind W. 21 mph (Ho, 1989). 22) Some observations taken at Wilmington, N.C.: Oct.30, 6 P.M. (E.S.T.), barometer 29.45 inches, wind N.N.E. 26 mph; 8 P.M., barometer 29.36 inches, wind N.N.E. 22 mph; 10 P.M., barometer 29.24 inches, wind N.E. 26 mph; midnight (Oct.30-31), barometer 29.13 inches, wind N.E. 30 mph; Oct.31, 2 A.M., barometer 29.03 inches, wind E. 26 mph; 3 A.M.,barometer 28.99 inches, wind E. 28 mph; 4 A.M., barometer 28.98 inches, wind E. 26 mph; 4:50 A.M., maximum wind S.E. 43 mph; 5 A.M., barometer 28.96 inches, wind S.E. 35 mph; 6 A.M, barometer 29.00 inches, wind S.E. 25 mph; 7 A.M., barometer 29.08 inches, wind S.S.E. 35 mph; 8 A.M., barometer 29.13 inches, wind S. 28 mph; 10 A.M., barometer 29.18 inches, wind S. 19 mph (Ho, 1989). 23) A large crowd boarded the Seacoast train for Wrightsville to witness for themselves the severity of the storm. One reporter from the Wilmington Messenger wrote: "The massive railroad trestle was warped and twisted, and for a few hundred feet extending from the station towards Hammocks the rails and ties were torn from the piles, and presented a tangled piled down in the waters of the sound... To the right and left, stretching around the sound, as far as the eye could reach, where but yesterday, as it were, the famous shell road wound in beautiful curves, was a mess of deep tangled debris of every conceivable kind, the wreckage of cottages from the beach and of boats and bath houses along the shore of the sound" (Barnes, 1995). 24) During the last 24 hours the Caribbean Sea storm has moved N. off the Florida and South Atlantic coasts and was central last evening S.E. of Wilmington, its progress having been about 29 mph. The storm has increased in intensity and has been attended by N.E. to N. gales of 30 to 60 mph, the latter velocity being reached at Cape Henry and Kitty Hawk (The New York Times, Oct.31, 1899, p.2, col.7). Author's note: The storm position to the S.E. of Wilmington was found to be too far to the E.; actually the storm was to the S. of Wilmington in the evening of Oct.30. The Monthly Weather Review, Oct. 1899 also mentions the maximum velocity of 60 mph which was reached at Cape Henry on Oct.30. 25) The Caribbean Sea storm has moved slowly N. and was central yesterday near Raleigh, where a barometric pressure of 29.34 inches was reported. The highest wind velocity reported during yesterday was 60 mph from the N.E. at Sandy Hook (The New York Times, Nov.1, 1899, p.2, col.6). 26) The first genuine storm of the autumn set in yesterday and hurricane signals were displayed along the coast. The storm brought a good deal of rain and winds that blew over 40 mph (The New York Times, Nov.1, 1899, p.7, col.6). 27) Philadelphia, Oct.31. The heavy N.E. storm outside the Delaware Capes reached its height today, when accompanied by rain, the wind blew over 60 mph. By noon the wind had moderated and was blowing about 55 mph. Along the coast the tides today were the highest in some years (The New York Times, Nov.1, 1899, p.7, col.6). 28) The storm has continued its progress along the Atlantic coast States with little change in energy and was central last night off the Maine coast (The New York Times.

Nov.2, 1899, p.2, col.7). 29) Some temperatures taken in the New York area on Nov.1, 1899 (in degrees Fahrenheit). Weather Bureau office, 3 A.M., 59; 6 A.M., 60; 9 A.M., 61; midday, 60; 4 P.M,, 60; 6 P.M., 59; 9 P.M.. 52. New York Times building, 3 A.M., 56; 6 A.M., 59; 9 A.M., 66; midday, 68; 4 P.M., 54; 9 P.M., 53 (The New York Times, Nov.2, 1899, p.2, col.7). Author's note: Differences in simultaneous temperature readings during daytime were attributed to the fact that The New York Times had its thermometer at 6 feet above the ground in the middle of the busy city whereas the thermometer at the Weather Bureau was located on top of the building 265 feet above ground level. The official Weather Bureau readings suggest that Nov.1. 1899 was a cool day in the New York area. 30) The Caribbean Sea disturbance has passed eastward over Newfoundland (The New York Times, Nov.3, 1899, p.2, col.4). 31) Some additional maximum velocities were as follows: Key West, N.W. 40 mph on Oct. 29; Raleigh, N. 41 mph on Oct.31; Hatteras, N.E. 46 mph on Oct.30; Norfolk, N.E. 50 mph on Oct. 31; Cape Henry, N.E. 72 mph on Oct.31; Cape May, N.E. 46 mph on Oct. 31; Atlantic City, N.E. 44 mph on Oct.31,; Philadelphia, N.E. 36 mph on Oct. 31; New York, N.E. 52 mph on Oct.31; Block Island, N.E. 57 mph on Oct.31; Boston, N.E. 31 mph on Oct. 31; Portland, Me., N.E. 21 mph on Oct.31 (Monthly Weather Review, Oct.1899). 32) Storm of Oct.26-Nov.5, 1899. Western Caribbean Sea, Cuba, inland over North Carolina (Tannehill, 1938). 33) Storm of Oct.29-31, 1899. Minor on the S.E. Florida coast, the center remaining offshore. Major in the Carolinas, high tides. Minor along the coast of the Middle Atlantic States, high winds and tides (Dunn and Miller (1960). Author's note: Ho (1989) has estimated a central pressure around 28.20 inches as the storm made landfall on the coast near the South Carolina- North Carolina border early on Oct.31; his estimate was found to support the major hurricane status which Dunn and Miller (1960) gave to this storm in the Carolinas. 34) Map showing a track for this storm. Positions along the track were as follows: Oct. 26 (morning), lat. 19.3 N., long. 78 W.; Oct.27 (morning), lat. 20 N., long. 81 W.; Oct.28 (morning), lat. 21 N., long. 82.5 W.; Oct.28 (evening), lat. 22.7 N., long. 83.7 W.; Oct.29 (morning), lat. 22.7 N., long. 80 W.; Oct. 29 (evening), lat. 24.5 N, long. 80.5 W.; Oct.30 (morning), lat. 26.7 N., long.78.7 W.; Oct.30 (evening), lat. 33 N., long. 76 W.; Oct.31 (morning), lat. 35.7 N., long. 76.3 W.; Oct.31 (evening), lat. 35.5 N., long 78.7 W.; Nov.1 (morning), lat. 41 N., long. 73.7 W.; Nov.1 (evening), lat. 43.5 N., long. 68.5 W.; Nov.2 (morning), lat. 48 N., long. 57.5 W. (Monthly Weather Review, Oct.1899). Author's note: Some of the storm positions above were found to be seriously erroneous. 35) An Oct.1899 storm appeared near lat. 19 N., long. 78 W., recurved near lat. 22 N., long. 81 W. and disappeared near Newfoundland. An accompanying track took the storm first to the S.W. of Cienfuegos; then recurved the storm over Cuba, bringing the center to the Florida Straits near Cardenas; next the storm motion was turned

northward off the Florida east coast until reaching the Carolina coast (Garriott, 1900). 36) A storm was first observed near lat. 13 N., long. 81 W. on Oct.26 and lasted 13 days; it was last observed near lat. 62 N., long. 15 W. (Mitchell, 1924). Author's note: The corresponding storm track shown in Mitchell (1924) was found to be quite similar to the one in Neumann et al. (1993) as for Storm 6, 1899. However, the latter authors started their track near lat. 12 N., long. 80.5 W. on Oct. 23 or three days earlier than Mitchell (1924) and brought the storm to near lat. 15 N., long. 81.3 W. by Oct.26.

Information in the 36 items above allowed the author of this study to introduce some modifications along the track shown in Neumann et al. (1993) as for Storm 6, 1899. After having examined information contained in the Historical Weather Maps for the period Oct.22-25 (not reproduced here), the author of this study seriously questioned the early track in Neumann et al. (1993) because suitable ship data, which were available for Oct.24 only, did not support a cyclonic circulation where, according to the above authors, the storm supposedly evolved during its incipient stages. On the basis of information in items 1) and 11) and after applying backwards some space-time continuity from his estimated storm position for the next day, the author of this study started his track with a 7 A.M. Oct.26 position estimated near 17.3 degrees N., 74.3 degrees W., which was about 450 miles to the E.N.E. of the corresponding position in Neumann et al. (1993) and suggested serious errors along their alleged track. The author's 7 A.M. Oct. 27 position was based on information in items 2), 3) and 11) and was estimated near 18.5 degrees N., 76.3 degrees W.; this position was about 360 miles to the E.N.E. of the one in Neumann et al. (1993). The author's 7 A.M. Oct.28 position was primarily based on information in item 5) and 11) and was estimated near 20.0 degrees N., 79.0 degrees W.; this position was about 120 miles to the E. of the corresponding one in Neumann et al. (1993). On the basis of information in items 7) and 11), in general, and in items 8) and 10), in particular, the author of this study decided to introduce a slight adjustment to the S.W. in the 7 A.M. Oct.29 position which is shown in Neumann et al. (1993), resulting in a new morning position near 22.7 degrees N., 80.0 degrees W. for that day. The 7 A.M. Oct.30 position in Neumann et al. (1993) was kept unchanged because it was found to be supported by morning observations for that day (item 19). On the basis of information in items 20) and 22), the 7 A.M. Oct.31 position in Neumann et al. (1883) was adjusted to the N. by about 70 miles to near 34.5 degrees N., 79.0 degrees W. 7 A.M. positions in Neumann et al. (1993) for the period Nov.1-4 were kept unchanged. The author's track is displayed in Fig.2.

The hurricane status which Neumann et al. (1993) gave to this

storm as for Storm 6, 1899 was found to be supported by information contained in a number of the items above. In fact, Storm 7, 1899 was a major hurricane in the Carolinas as indicated in item 33). On the basis of the content of item 6) and observations taken at Tunas de Zaza (items 5, 7 and 8), the author of this study believed that the storm reached hurricane intensity during Oct.28 and, therefore, introduced such intensity along his track on that day. Because the storm was a major hurricane at landfall on the Carolina coast early on Oct.31, the author decided to keep the hurricane status during most of that day, changing it into the one corresponding to the extratropical stage as the storm crossed the 37 degrees N. parallel. Temperatures in item 29) showed that the system exhibited extratropopical characteristics as it reached the vicinity of New York in the morning of Nov.1.

Storm 8, 1899 (Nov.7-10), T. S.

This is a case which has been recently unearthed by the author of this study. Strictly speaking, this is not a new case because it was listed in the catalog of Cuban cyclones by M. Gutierrez-Lanza, and its existence was published in The New York Times, Diario de la Marina (Havana, Cuba) and the Monthly Weather Review, Nov.1899. However, this storm might be considered as a new one from the standpoint that it is not included in Neumann et al. (1993).

Documentation of this storm was based on the following information: 1) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Nov.7, ship near lat. 12 N., long. 80 W., wind W.N.W. force 2, barometer 29.71 inches; ship near lat. 13 N., long. 76.7 W., wind E.S.E. force 4, barometer 29.94 inches (probably too high). Nov.8, Kingston, wind N. force 2, rain, barometer 29.89 inches; Santiago de Cuba, wind N.E. force 3, barometer 29.92 inches; Port-au-Prince, wind E. force 3, barometer 29.87 inches; Camaguey, wind N.E. force 3, barometer 29.96 inches; ship near lat. 19 N.,long. 75 W., wind S.E. force 3; ship near lat. 15.7 N., long. 75 W., wind N.E. force 5, barometer 29.91 inches; ship near lat. 12 N., long. 77.3 W., wind N.E. force 3, barometer 30.03 inches (too high). Nov.9, Santiago de Cuba, wind S.E. force 4, barometer 29.83 inches; Camaguey, wind N.E. force 3, barometer 29.84 inches; Cienfuegos, wind N.E. force 2, barometer 29.90 inches; ship near lat. 22.7 N., long. 73 W., wind E. force 4, barometer 29.86 inches; ship near lat. 21 N., long. 73 W., wind E.S.E. force 6; ship near lat. 19.8 N., long. 74 W., wind E. force 4, barometer 29.83 inches; ship near lat. 19.8 N., long. 79.7 W., wind N.E. force 5, barometer 29.88 inches. Nov. 10, Camaguey, wind N.E. force 2, barometer 29.85 inches; Santiago de Cuba, wind S.W.

force 1 (barometer could not be read off the map); ship near lat. 27.5 N., long. 74 W., wind N. force 4, barometer 29.94 inches; ship near lat. 26.7 N., long. 70 W., wind S.W. force 5, barometer 29.94 inches; two ships near Crooked Is. with wind N.E. forces 3 and 4, one of them reporting a barometer reading of 29.86 inches (Historical Weather Maps, Nov.1899). 2) Belen College Observatory, Nov.8, 6 P.M. Our observer at Santiago de Cuba, Mr. Mason, reported to us by a cablegram this afternoon: "Holland Bay, Jamaica, strong tempest since daybreak, continuous rain, wind now blowing from S.W. Here (at Santiago de Cuba), barometer 29.89 inches, intermittent light rain, wind light from S.E." Although this is not the ordinary time for cyclones we will try to inform the public about any emergency. L. Gangoiti, S.J. (Diario de la Marina, Havana, Nov,9, 1899, morning edition, p.2, col.6). 3) Belen College Observatory, Nov.9, 7 P.M. The observer at Santiago de Cuba has sent several telegrams to us. At 2:30 P.M. we received the following one: Manzanillo, during the early morning wind N.E. 40 mph; this morning wind N.; now wind W. with a tendency to become S.W., barometer went down three tenths (it should probably read 3 millimeters which are about 12 hundredths of an inch), cyclonic weather, barometer still low, requesting from captain of the "Josefita" to telegraph you last night observations. At 5:30 P.M. a telegram was received from the captain of the "Josefita", at Manzanillo: "Very rainy weather was observed last night. wind from N.E., seas from S.W., barometer 29.75 inches; barometer rose in the early morning, the sight of Cape Cruz (from Manzanillo) has cleared". It is clear that this morning there was a tempest of slight intensity to the S.E. of Havana, near Cape Cruz. There has been gusts from the S.E. at Santiago de Cuba and the cable communication with Jamaica was interrupted. L. Gangoiti, S.J. (Diario de la Marina, Havana, Nov.10, 1899, morning edition, p.2, col.8). 4) The meteorological observatory of the Weather Bureau has told us by phone that there was a tempest to the S. of the province of Santiago de Cuba, which is moving to the N.W. and will cause winds from S.W. to E. over the eastern part (of Cuba) and from the N.W. over its western portion (Diario de la Marina, Havana, Nov.10, 1899, evening edition, p.2, col.1). Author's note: The above information was probably given to the newspaper in the morning of Nov.9. 5) Belen College Observatory, Nov.10, 10 A.M. The tempest that appeared near Holland Bay (Jamaica) on Nov.8 and that yesterday morning caused a moderate tempest at Manzanillo, in all likehood has moved away from the island (of Cuba), after having caused rains and winds that were not very strong. It was mainly felt in the eastern region of the island. L. Gangoiti, S.J. (Diario de la Marina, Havana, Nov.10, 1899, evening edition, p.2, col.1). 6) A disturbance off the S. coast of eastern Cuba has caused strong winds and heavy rain over Cuba and Jamaica with a maximum reported rainfall of 5.70 inches in 48 hours at Santiago de Cuba. The minimum barometric pressure noted yesterday was 29.76 inches at Santiago (de Cuba) and Puerto

Principe (Camaguey) and the maximum wind velocity was 30 mph at Havana (The New York Times, Nov.10, 1899, p.2, col.5). 7) The Caribbean Sea disturbance has apparently dissipated (The New York Times, Nov.11, 1899, p.2, col.6). 8) A severe storm visited the island of Jamaica on Nov.8-9, causing considerable damage to property and crops from the east end of the island to Morant Bay in the S. and to Lucea on the north coast (Monthly Weather Review, Nov.1899). 9) From a report of the Havana forecast district sent to the Weather Bureau by W.B. Stockman, Forecast Official: On the morning of Nov.9 Cuban stations and Kingston, Jamaica, were notified that a storm was apparently central S. of eastern Cuba. In the afternoon the Jamaica cable was interrupted. At 4 P.M. Santiago de Cuba and Puerto Principe (Camaguey) were informed that the storm was moving N.N.W. and that rains and high southeasterly winds, backing to easterly were indicated for eastern Cuba, and all Cuban stations warned of rain and high winds. Reports from Kingston, dated on Nov.8, received the afternoon of Nov.9, indicated very stormy conditions over that place, and cablegrams to newspapers in the United States confirmed these reports. No authentic reports of reported damage on the Island of Jamaica on Nov.8 have been received. (Monthly Weather Review, Nov.1899). 10) Maximum wind velocity at Kingston, Jamaica, was N.W. 24 mph on Nov.8 (Monthly Weather Review, Nov.1899). 11) Nov.8-9, 1899. A cyclone of weak intensity crossed over Santiago de Cuba province. There were no casualties, but it caused damage to buildings and crops. The vortex passed to the E. and near Kingston and emerged into the Atlantic near Gibara (Sarasola, 1928). Author's note: Actually taken from the catalog of Cuban cyclones by M. Gutierrez-Lanza which is included in Sarasola (1928). Gibara is located on the northern coast of eastern Cuba at lat. 21 09 N., long. 76 11 W. The Atlas Nacional de Cuba (Academia de Ciencias, 1970) also mentions this storm as a cyclone of weak intensity which affected Oriente (Santiago de Cuba) province. Finally, it should be mentioned that, according to the nomenclature used in reference to storms in Cuba, the word "cyclone" normally refer to those storms attaining hurricane intensity. 12) Kingston, Jamaica, Nov.9. Owing to the extent and gravity of the reported destruction and consequent distress throughout the island from the late storm which only now is been fully realize, the Gleaner today urged the Government to institute a systematic inquiry for the purpose of ascertaining the details and furnishing relief (The New York Times, Nov.10, 1899, p.7, col.2). 13) Kingston, Jamaica, Nov.10. Communication with the eastern part of this island has been partially reestablished and advices from various points show that on Wednesday (Nov.8) the heavy weather culminated in a tremendous hurricane which during the night completely razed the banana and other perishes (The New York Times, Nov.11, 1899, p.7, col.2). 14) Kingston, Jamaica, Nov.11. The storm struck the east end at 1 o'clock (apparently in the afternoon) and raged along the northern slopes for 4 hours. Port

Antonio experienced serious damage to property, including the United Fruit Company's wharf and premises, etc. But the main force of the cyclone apparently struck Morant Bay to Priestman's River which district is still totally cut off. The town of Morant Bay is shattered (The New York Times, Nov.12, 1899, p.7, col.5). 15) At Campechuela, near Manzanillo, during the late storm a ceiba tree crashed into a farmhouse instantly killing the owner's wife and 3 children, wounding him seriously (Diario de la Marina, Havana, Nov.15, 1899, morning edition, p.1, col.2). 16) During a recent storm in Camaguey, the new hospital, in course of construction by the American military authorities, was blown down, wounding 8 workmen and slightly injuring several others (Diario de la Marina, Havana, Nov.17, 1899, evening edition, p.2, col.5). Author's note: The above accident might not be associated with this storm; however, it looks that it most likely was.

On the basis of information contained in the above items, the author of this study prepared an approximate track for Storm 8, 1899. His track was started with his 7 A.M. Nov. 7 position near 12.7 degrees N., 77.5 degrees W. which was estimated by using ship information for that day contained in item 1). The author's 7 A.M. Nov.8 position was near 17.0 degrees N., 76.5 degrees W. and was estimated after a careful analysis of information in items 1) and 2).The author's 7 A.M. Nov.9 position was estimated near 20.7 degrees N., 76.7 degrees W., chiefly on the basis of information in item 3). The author's 7 A.M. Nov.10 position was based on ship information for that day (item 1), particularly that pertaining to ships to the north of the 25 degrees N. parallel; such a position was estimated near 27.5 degrees N., 71.4 degrees W.. It should be mentioned that the author had higher confidence in his position estimates for Nov.8-9 than in his estimates for Nov.7 and Nov.10. The author's track is displayed in Fig.2.

Although information contained in several items, item 11) in particular, suggested that this storm reached hurricane strength, the author of this study decided to keep it as tropical storm because no evidence of measured hurricane winds or pressures supporting hurricane intensity was found in the above items.

Special statement.

In addition to the storms which were discussed above, three possible cases were found for 1899. Available information about

these cases was found to be insufficient to assess the true nature of these weather systems and/or their evolution.

A) Case of Sept. 24-26.

The following information was found about this possible case: 1) Taken from 8 A.M. (E.S.T.) weather maps: Sept.24, center of a low placed near lat. 10 N., long. 49.5 W. Sept.25, ship near lat. 18 N., long. 54 W., wind S.E. force 4, barometer 29.62 inches; ship near lat. 15 N., long. 58 W., wind N.W. force 7, barometer 29.38 inches; center of a low placed near lat. 16.5 N., long. 55 W. Sept.26, no data around the center of a low which was placed near lat. 12 N., long 55 W. (Historical Weather Maps, Sept.1899). Author's note: The barometer reading of 29.38 inches reported by a ship near lat. 15 N., long. 58 W. appears to be too low. The above information was judged to be insufficient to determine if this weather system, which apparently had a well-defined closed circulation, attained tropical storm intensity while E. of the Lesser Antilles. This is why this system is kept as a possible case.

B) Case of Oct.7-9.

The following information was found in relation to this possible case: 1) Taken from 8 A.M. (E.S.T.) weather maps: Oct.7, ship near lat. 21 N., long. 62 W., wind N.E. force 5, barometer 29.80 inches; ship near lat. 21.5 degrees N., long. 65 W., wind N.E. force 4, barometer 29.80 inches (probably too low); San Juan, wind S. force 1, barometer 29.88 inches; St. Kitts, N.E. force 2, barometer 29.87 inches; center of a low placed near lat. 20 N., long. 60 W. Oct.8, San Juan, wind W. force 3, barometer 29.85 inches; St. Kitts, wind W. force 3, barometer 29.81 inches; Dominica, wind S.W. force 2, barometer 29.84 inches; ship near lat. 23.7 N., long. 59 W., wind S.E. force 5, barometer 30.03 inches (probably too high); ship near lat. 22.7 N., long. 67 W., wind N.E. force 4; ship near lat. 24 N., long. 68 W., wind N.N.E. force 5, barometer 29.74 inches; center of a low placed near lat. 19.5 N., long. 62.5 W. (too far S. and E.). Oct.9, ship near lat. 26 N., long. 70 W., wind N.N.E. force 5, barometer 29.77 inches; ship near lat. 28 N., long. 68 W., wind S.E. force 4, barometer 29.91 inches; ship near 27 N., long. 68 W., wind S.E. force 2, barometer 29.88

inches; ship near lat. 22.7 N., long. 68 W., calm, barometer 29.91 inches; center of a low placed near lat. 24.5 N., long. 70 W., but ship data suggested that the center was actually to the E. of that location (Historical Weather Maps, Oct.1899). The information above supported the existence of a low pressure area near the Lesser Antilles on Oct.7 which moved to the N.W. and N. during the next two days; however, tropical storm intensity could not be inferred from the available information and this is why this weather system was kept as a possible case.

C) Case of Oct.10-14.

The following information was found about this possible case: 1) Taken from 8 A.M. (E.S.T.) weather maps: Oct.10, ship near lat. 9 N., long. 34 W., wind S.S.W. force 9, barometer 29.77 inches. Oct. 14, ship near lat. 21.7 N., long. 42 W., wind S.S.E. force 8 (Historical Weather Maps, Oct.1899). The ship observations above suggested the existence of a well-developed low pressure area well to the east of the Lesser Antilles which seemed very likely to have attained tropical storm intensity. As a matter of fact, gales (wind force 8-9) were reported by ship observations on Oct.10 and on Oct.14, but there was no way to verify them in the light of additional information because there were no other observations near the low pressure area on the above nentioned days and over the period Oct.11-13. The low pressure area appeared to have moved to the N.W. but not even an approximate track for it could be inferred. Under the above circumstances, the author of this study decided to keep this one as a possible case.